Canada Alberta

FOREST RESOURCE DEVELOPMENT AGREEMENT
ENTENTE SUR LA MISE EN VALEUR DES RESSOURCES FORESTIERES

Canada Alberta

89-01407/

The Canada-Alberta Forest Resource Development Agreement is a subsidiary agreement of the Canada-Alberta Economic and Regional Development Agreement, which provides coordination and cooperation between the governments of Alberta and Canada in areas of Alberta's economic development.

The Canada-Alberta Forest Resource Development Agreement is funded equally by the governments of Canada and Alberta, from April 1, 1984, to March 31, 1989.

Its primary objectives are to ensure the long-term availability of timber supplies; to optimize timber uses; and to contribute to the growth and diversification of Alberta's economy.

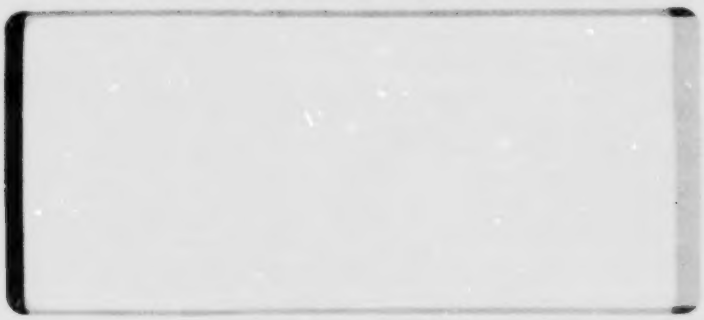
The Agreement comprises three programs: Reforestation; Applied research, technology transfer and opportunity identification; and Public information, evaluation and administration. These programs are managed by a joint Directorate and are implemented by the Canadian Forestry Service and the Alberta Forest Service.

L'Entente Canada-Alberta sur la mise en valeur des ressources forestières est auxiliaire à l'Entente Canada-Alberta sur le développement économique et régional, qui vise à assurer la coordination et la coopération des deux gouvernements relativement au développement économique de l'Alberta.

L'Entente Canada-Alberta sur la mise en valeur des ressources forestières est financée à parts égales par les gouvernements du Canada et de l'Alberta, et a cours du 1er avril 1984 au 31 mars 1989.

Ses objectifs principaux sont assurer la disponibilité à long terme de réserves de bois; optimiser leur utilisation; et contribuer à la croissance et la diversification de l'économie de la province.

L'Entente comprend trois programmes: Reboisement; Recherche appliquée, transferts de connaissances techniques et relevé des occasions; et Information, évaluation et administration. Ces programmes sont gérés par un Bureau de direction conjoint, et mis en oeuvre par le Service canadien des forêts et le Service forestier de l'Alberta.



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REPORT ON CEMENT BONDED PARTICLEBOARD, ITS APPLICATIONS AND A PRELIMINARY ASSESSMENT OF A PLANT TO BE LOCATED IN ALBERTA

Ligna Technologies Ltd.[1]

1987

This is a joint publication of the Canadian Forestry Service and the Alberta Forest Service pursuant to the Canada-Alberta Forest Resource Development Agreement

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DISCLAIMER

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The views, conclusions, and recommendations are those of the authors. The exclusion of certain manufactured products does not necessarily imply disapproval nor does the mention of other products necessarily imply endorsement by the Canadian Forestry Service or the Alberta Forest Service.

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ABSTRACT

Introduction

The Fulgurit CBPB plant in West Germany, established in 1975, was shut down in 1985 as Eternit, a German competitor long established in the asbestos cement board business, started a new plant with a much larger capacity, therefore, with lower production costs.

Ligna Technologies Ltd., engaged for a long time in the technology of CBPB production and application through its President, Steve Simon, P.Eng., considered the above as a unique opportunity and has approached various potential investors who needed a preliminary engineering, market and financial study before they would put further effort and funds in a detailed feasibility study.

Ligna signed a contract bearing number O1K45-7-0080/01-EDM with the Canadian Forestry Service to conduct such a study.

Engineering Study

The Engineering Study deals with the description of CBPB, comparison to other board products, its historical development, ingredients, exterior and interior applications, workability and specifications.

In the section dealing with historical development some new fast curing processes are mentioned but only the Bison method is considered in this study. Only one of the newer processes is operating in a full-scale plant with the rest still on drawing boards on in laboratories. The one developed in Finland requires a component delivered to Alberta at prohibitive cost.

Market Survey

A brief market survey established the type of current board products and applications where CBPB is better qualified and/or lower priced, indicating also whether the market could absorb the output of the Fulgurit plant at what selling price.

Financial Analysis

The total capital cost requirement of the Fulgurit plant, operating in Alberta, was investigated along with product cost calculations.

The above work was done on two alternative jobsites, the Edmonton area and Cochrane outside of Calgary. Similarly investigation was also performed on a new plant of same size and technology offered by Fulgurit's original builder, Bison.

A gross selling price was assumed in competition with other similar board products. Financial projections include balance sheets, income and expense statements, cash flows, and detailed backup documentation.

Summary

There is a strong indication that at a $ 25.00 list price per 4' x 8' sheet an immediate market exists for CBPB to absorb at least 15,000,000 square feet per annum, reaching the Fulgurit plant's total capacity of 20,000,000 in less than five years.

The only difference between the two jobsites is that land in Edmonton costs $ 10,000 less than in Cochrane while production costs are lower in Cochrane due to lower delivered cement cost by accumulative amount of approximately $ 500,000 over five years.

The total capital cost of the Fulgurit plant is $ 6,730,000 against the $ 13,505,000 of a new Bison plant.

The production cost of a new Bison plant is identical to that of a Fulgurit plant.

The Fulgurit plant is profitable in the second year while a new Bison plant will show profit only in the fourth year.

The Fulgurit plant is a unique investment opportunity for a fast return on investment (10?% by the end of the fifth year) while a new Bison plant is at the best only average (9% by the end of the fifth year).

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1. INTRODUCTION

This study was prompted by the availability of the Fulgurit plant, a West German cement bonded particleboard (CBPB) manufacturing facility. Ligna Technologies Ltd., engaged for a long time in the technology of CBPB production and application through its President, Steve Simon, P.Eng., considered the above as a unique opportunity and has approached various investors who required investigation in the following areas before they would put further effort and funds in a detailed feasibility study:

- Engineering study to determine the capital cost of purchasing and re-establishing the Fulgurit plant in Alberta and the calculation of product cost at the two proposed jobsites;
- Market survey of similar board products for either an Edmonton or a Calgary plant location;
- Financial analysis of the project, including a comparison with a new plant of the same design and capacity.

2. ENGINEERING STUDY

2.1 Product Description

Cement Bonded Particle Board (CBPB) is suitable for exterior and interior use; it is asbestos free, it contains no hazardous volatiles, its process dust is non-aggressive, and it may be sawn, planed, sanded, drilled, routed, nailed and screwed with hard tipped woodworking tools and machinery.

CBPB's main properties are its resistance to fire and rot, its excellent sound attenuation, its workability, its acceptance of a wide variety of finishes and that static electric charges do not build up on it.

CBPB is strong, robust against impact (which reduces accidental damage), and is durable even when unprotected, being able to withstand the destructive influences of weather, moisture, fungus, insects and vermin. Its structure is monolithic, so that it does not laminate nor are exposed sawn edges vulnerable to damage by weather. Tests have been carried out in far more arduous conditions than those found in practice, such as 150 freeze-thaw cycles alternating between +20°C and -20°C, which produced no significant change in the material.

In summary the principal attributes of CBPB are:

- Durability
- Workability similar to other timber products
- Fire resistance

- Resistance to attack by termites, fungus and insects
- Does not contain asbestos, formaldehyde or any other toxic substance
- Low sound transmission properties
- Acceptance of a wide range of surface treatments such as veneers, laminates, high and low technology paints etc.

Because of its virtually incombustible nature and because it presents no health hazard, CBPB provides an economical and, in many respects, superior substitute for asbestos cement board.

Table 1. compares the properties of CBPB with other commonly used building boards.

2.2 Product Development

Historically many buildings have been constructed using one of two traditional materials, either cement or timber. In the 1920's work commenced to develop a building component combining both materials and a substantial amount of work was carried out in Europe to explore the physical chemistry of the relationship between wood and cement. By the late 1920's it was common practice to use woodchips instead of particles of stone to manufacture building blocks. Buildings erected from these early building blocks are still in excellent condition.

By 1940 a process had been developed by which very long strands of wood, produced by means of a planing process, were combined with cement and semi-compressed to produce WOODWOOL SLABS.

Following the commercial success of WOODWOOL SLABS further substantial research was conducted and a Swiss company DURISOL AG developed a process for producing a high density particle board using a small wood flake. The first plant to manufacture CEMENT BONDED PARTICLE BOARD commenced production in Switzerland in 1973. The product was named DURIPANEL and it gained a considerable reputation in Switzerland where today approximately 6,000 cubic metres are used each year.

In 1974 DURISOL decided to offer manufacturing licences internationally and entered into an arrangement with BISONWERKE of West Germany who manufactured and marketed the plants to designs, and using production technology, supplied by DURISOL. Although that arrangement has now lapsed, manufacturing plants were constructed in West Germany, Hungary, Vietnam, Japan, Russia, Malaysia, Mexico, Finland and Italy. The first German plant was Fulgurit, starting production of its CBPB, called Isopanel, in 1975.

In the 1970's, when the health problems associated with the use of asbestos were receiving considerable adverse publicity, the asbestos companies all commissioned research and development to find a replacement product for asbestos cement board which had hitherto dominated the market in fire protection. In 1973 one of the largest of these, ETERNIT AG, purchased DURISOL so as to gain access to an

TABLE 1

COMPARISON OF CBPB TO OTHER BOARD PRODUCTS

CHARACTERISTICS Good - 1 Fair - 2 Poor - 3	Chipboard	Plywood	Plasterboard	Timber	Hardboard	Fibreboard	Asbestos Cement	CBPB
Fire Resistance	2/3	3	1	3	3	3	1	1
Weather Resistance	3	2	3	2	3	3	1	1
Unaffected by water immersion	3	3	3	3	3	3	1	1
Termite resistance	3	3	1	3	3	3	1	1
Rot resistance	3	3	1	3	3	3	1	1
Impact resistance	1	1	3	1	2	3	3	1
Durability	3	3	1	2	2	3	1	1
De-lamination resistance	1	2	3	1	2	3	1	1
Variation in thickness	3	2	1	3	2	3	1	1
Machinability	2	2	3	1	3	3	3	1
Fungus resistance	3	3	1	3	3	3	1	1
Sound transmission	3	2	3	2	3	3	3	1
Dimensional Stability	2/3	2	2	3	3	3	1	1
Substrate suitability	2	2	3	2	3	3	2	1

Ligna Technologies Ltd., 1987

alternative technology backed by over 30 years of research and development work.

A sister company in the Eternit Group built a large plant at Neubeckum, Germany, to produce DURIPANEL alongside their existing asbestos cement production processes. This plant was commissioned in 1981 and incorporated the latest development in technology acquired from DURISOL.

Eternit did not wish to continue DURISOL'S policy of plant sales and following the successful design, construction and commissioning of the production plant at Neubeckum by the DURISOL engineers and chemists, ETERNIT AG closed the DURISOL engineering research and development facility and the engineers who had been responsible for all of the development work and process technology left to join VERSATEC AG, a member of the CHESSMINSTER GROUP of companies which had been selling and distributing DURIPANEL in the United Kingdom and elsewhere.

VERSATEC has subsequently improved the physical chemistry and manufacturing process and has patented the equipment related to these improvements. VERSATEC has also developed factory designs that allow incremental increases of capacity.

THE CHESSMINSTER GROUP is constructing its own manufacturing plant using the latest VERSATEC technology and will market the product as DORICPANEL.

ETERNIT of Germany started a marketing effort in the U.S.A. four years ago to introduce CBPB under the trade name of ETERSPAN. The distributor, GII Corporation of Reading, PA appointed ABS LTD of Toronto in 1984 as their Canadian agents.

BISONWERKE supplied 26 CBPB plants to date, one recently to Mexico for GRUPO GUADIANA who started marketing the product in the USA through TIMBER SYSTEMS of El Paso, Texas. Their panels have received complete ASTM testing and UL fire-rating. The plant also produces complete, pre-fabricated, low cost houses.

BISONWERKE announced in May 1987 at the Ligna Fair in Hannover, Germany that they have developed a new, fast curing technology for CBPB, eliminating from the manufacturing process expensive heavy equipment needed to maintain pressure during the 6-8 hours curing time of the original process. The first such plant is expected to be built in 1988 at a site not disclosed at this time.

Recently, RAUTE of Finland has introduced a similar method for the manufacture of CBPB called the ECOCEM process. It uses finely ground blast furnace slag as the bonding material which is cured when activated by a chemical agent, much faster than portland cement, thus reducing equipment cost. The added advantage is that slag is not sensitive to the chemistry of fiber used in board manufacturing, especially to water soluble sugar content, also that chemically bonded particleboard plants can be easily converted to CBPB. There is now such a plant in operation in Finland.

A similar process, developed by Dr. L. Paszner at the University of British Columbia, uses magnesite cement as the bonding material. Again, fast curing and insensitivity to sugar content makes it potentially advantageous. RAUTE of Finland used this process before developing the ECOCEM process but good quality MAGNESITE had to be imported from China, again at prohibitive prices, while slag cement was available in Finland.

One of the early Bison - plants, built in Hungary, has also developed fast curing chemistry independently of others and licenced their patents to RAUMA REPOLA, another engineering company from Finland. This process cures the cement by blowing CO_2 through the mat prior to pressing. It requires complex additional equipment; the results will be seen only in 1988 when the first production line goes into service in Hungary.

2.3 Ingredients

The main ingredients of CBPB are the familiar, proven and traditional materials of cement and wood fibres, blended with additives that "mineralise" the wood fibres.

The cement is ordinary Portland cement produced to the standard PZ 450, DIN 1164, 3200 blaine, or similar.

Whilst wood is the most common source of fibre, it is now feasible, with the appropriate additives and pre-treatments, to bond practically any organic fibre with cement. Thus vegetable substances of various kinds and shapes, including wood of European and non European origin, bagasse from sugar plants, textile fibres, rice husks, various grasses and cereal plants, reeds, papyrus and other sedges, cotton stalks etc., can be used and CBPB offers the possibility of turning a country's waste products into a valuable and profitable building material.

The source of fibre can have a significant impact on the physical performance of the board and it should be noted that the values quoted in this document are based on the European practice of using wood fibres.

The additives are chemicals that mineralize the fibres and neutralize the substances in them which inhibit the cement from curing. These additives are non poisonous and non pollutant and are generally available in adequate quantities in almost every country in the world. Their price, as a proportion of the finished product, is almost negligible.

The "mineralisation" process enables the fibres to resist erosion and decay. "Mineralisation" means the transformation of an organic substance into a state where it is almost as resistant to biological, chemical, weathering attack and to fire as mineral building materials are by nature.

In the case of the wood or other fibres contained in cement-bonded materials, the mineralising effect of the silicates in the cement alone is generally sufficient to protect the relatively thin fibres from rot and decay. But in most cases a chemical pre-treatment is provided, which provides an additional preservation to the fibres and which also improves their processability, their affinity to cement and thus the quality of the panel.

Moisture, which in combination with aeration generally favours decay, does not have a degrading influence as the cement encased fibres do not constitute a medium for bacteria and fungi. In addition, the alkaline conditions efficiently obstruct the development of fungal cultures in the long term.

Light which is known to cause the breakdown of wood, has no effect on the "mineralised" fibres.

2.4 Applications

CBPB is versatile and since its inception in the 1960's, has been successfully used in varying climates ranging from hot to cold and wet to dry and its unique properties make it an ideal exterior and interior building material.

2.4.1 Exterior Uses:

CBPB's outstanding weathering properties make it particularly suitable as an external cladding material since faces and sawn edges may be left unprotected without any risk of damage from rain, frost or rot.

Other exterior applications include:

- flat roofing
- prefabricated house/units
- mobile housing
- permanent formwork
- balcony parapets and floors
- cladding for industrial factories, workshops, warehouses
- tunnel linings
- sound attenuating barrier walls
- fire barriers
- pavilions
- containers
- separating walls
- soffits
- agricultural buildings for livestock or feed storage.

2.4.2 Interior Uses

CBPB, being virtually incombustible, is finding increasing usage as an interior wall lining, especially in public and medical buildings. The board is also useful for cold or humid rooms, including bathrooms, showers, washrooms, kitchens, cheese curing rooms and dairies.

Other interior applications include:

- sound insulating and fire resisting partitions
- cladding for timber frame housing
- fire resistant floor, wall and ceiling linings
- fire doors
- fire resistant furniture
- built-in furniture
- steel support beam and column casings
- cavity flooring for computer rooms
- shaft and duct linings
- panelling for electrical and gas appliances
- wet room linings
- livestock building linings
- glue laminated structural members
- air ventilation ducts
- refuse shafts
- 'heat sink' roofing for low energy buildings.

2.4.3 Workability

CBPB can be worked using hard tipped tools and conventional carpentry and joinery practices in the same manner as timber, plywood or chipboard.

Any edge shapes can be produced, such as tongue and groove, rebates, mitres, rounds, bevels, etc., and these often have greater strength than when produced in natural timber or chipboard, owing to the monolithic nature of CBPB.

Tests by Black and Decker Professional Division show that wear on tools can actually be reduced when working CBPB compared with resin bonded chipboard because the possible speed of operation is often faster.

2.4.3.1 Sawing

Ordinary cross cut hand saws, or jig saws with coarse blades, or power saws with tungsten tipped blades should be used.

2.4.3.2 Drilling

A hand drill, or high speed power drill (not the percussion type) should be used.

2.4.3.3 Planing

A "Surform" or similar rasp type tool is recommended.

2.4.3.4 Sanding

CBPB can be sanded manually or by using a mechanical sander.

2.4.4 Applied Finishes

CBPB has a smooth surface ready for decoration. Before applying finishes, any dust should be removed with a slightly damp clean cloth. Screw holes, surface damage or uneven joints can be easily remedied with proprietary filler. Before any finish is applied the recommendations of the manufacturer of the decorative material should be checked so that the correct procedure is followed, particularly with regard to priming.

The following materials are regularly and successfully applied to CBPB:

2.4.4.1 Paints

- emulsion
- resin based
- lead
- cement
- chlorinated rubber
- anti-condensation

Where painted boards are exposed to damp conditions, backs and edges should be sealed prior to mounting to avoid warping.

2.4.4.2 Plasters

- synthetic polymer
- gypsum
- cement rendering

2.4.4.3 Wall Paper

- vinyl
- cloth
- paper

2.4.4.4 Tiles

- ceramic
- plastic
- metal

2.4.4.5 Decorative laminates

- plastic
- wood
- metal

A compensator must always be applied to the reverse side when applying laminates or veneers to one side only to prevent warping.

2.4.5 Fixing Methods

CBPB can be fixed using conventional methods:

2.4.5.1 Nails

CBPB boards up to 12mm thick can be nailed without pre-drilling. For nailing through greater thicknesses, pilot holes should be drilled. When power nailing, pre-drilling is not necessary for any thickness. Shotfiring is also possible.

2.4.5.2 Screws

For general manual screw fixing, a slightly oversized hole should be pre-drilled, with counter sinking if required. Pre-drilling for any thickness of CBPB is not necessary when power screwing using various types of self-drilling and self-embedding headed screws.

2.4.5.3 Bonding

CBP is alkaline having a pH value of 11.13 hence PVA and resorcinol glue lines are recommended for bonding CBPB.

2.4.6 Product Specification

2.4.6.1 Appearance

CBPB is light grey in colour and is produced with two types of surface finish: Standard and Calibrated.

2.4.6.2 Finishes

Standard finish is suitable for most applications;

Calibrated finish is produced by accurately sanding both sides simultaneously, and is used where a tolerance is demanded, or where it is to be faced with a decorative laminate or veneer.

2.4.6.3 Density

Approximately 1250kg/m^3.

2.4.6.4 Dimensions

Width: 1250mm.
Length: 2600 and 3100mm.

2.4.6.5 Thicknesses

Standard:	6, 8, 10, 12, 16, 18, 20, 24, 28, 32 and 40mm.
Calibrated:	6, 8, 10, 12, 16, 18, 22, 25, 29 and 36mm.

2.4.6.6 Tolerances

Thickness	Standard Finish	Calibrated Finish
6 - 12 mm	±0.7mm	±0.3mm for all thicknesses
16 - 24mm	±1.0mm	
28 - 40mm	±1.5mm	
Length and Width	±5.0mm.	

2.4.7 Performance

2.4.7.1 Mechanical

Modulus of elasticity	3000 N/mm^2
Modulus of rupture	9 - 13N/mm^2
Compressive strength	15 N/mm^2

Tensile strength Perpendicular to surface 0.35 N/mm
Parallel to surface 4.00 mm^2

Extraction Resistance N per 10 mm depth

	Board Thickness	Face	Edge
Screws	12 mm	98 N	50 N
	18 mm	139 N	77 N
	24 mm	162 N	92 N
Nails	12 mm	40 N	13 N
	18 mm	53 N	24 N
	24 mm	83 N	37 N

2.4.7.2 Fire

Fulgurit ordered tests for its CBPB as non-combustible protective panels. Arnold Green Testing Laboratories Inc. of the USA has conducted these tests. The test report, according to UL Specfications 1482, is attached. (See Appendix B)

2.4.7.3 Water

Mositure content 9% +/- 3% by weight, ex works. CBPB will adjust to ambient moisture conditions and moisture content can reach up to 35% in high humidity.

Moisture Movement 0.03% for each percent change in moisture content.

2.4.7.4 Chemical

Alkalinity. CBPB has a pH value of 11 - 13.

2.4.7.5 Biological

CBPB is resistant to fungus, insects and vermin.

2.4.7.6 Thermal

Thermal Conductivity k-value is 0.35 W/m deg. C.
Linear Thermal Expansion 0.01 mm/m deg. C.
Frost Resistance: A reduction of bonding strength of about 10% occurs after 50 frost dew cycles between - 20°C and + 20°

2.4.7.7 Acoustic

Sound reduction for standard finish single board in db

Thickness (mm)	6, 8, 10, 12, 16, 18, 20, 24, 28, 32, 40
Sound reduction db	28, 30, 31, 31, 33, 33, 33, 35, 36, 37, 38

2.4.7.8 Electrical

CBPB is resistant to tracking and therefore can be used as backing panels for electrical appliances. It will not build up static electrical charges.

These specifications may vary as a result of differences in locally supplied raw materials.

2.5 Summary

Due to the prohibitive transportation cost of blast-furnace slag from Hamilton, Ontario, the closest available source to Alberta, this study does not consider the ECOCEM process as viable. Similarly, other processes, mentioned above, are not in full scale operation as yet and, therefore, not considered at this time.

Ligna, due to the availability of the Fulgurit plant, has considered only the portland cement-based process and compared the capital cost, production cost and financial analysis of the Fulgurit plant, re-erected in Canada, with those of a similar new Bison Plant. For process description, list of machinery, manning requirements, etc., identical for both the Fulgurit plant and a new Bison plant, see Appendix A.

It is possible to tailor some properties to the requirements of different applications. Table 2 shows mechanical and physical properties as a function of density, published by Eternit of Germany, a similar Bison-built plant.

Further information on Fulgurit's Isopanel, especially on application details, is presented in Appendix D.

Capital cost and product cost calculations are presented in the Financial Analysis Section.

TABLE 2

MECHANICAL PROPERTIES	VALUE
Modulus of Elasticity	
parallel to fibers	2.26 × 10⁶ lb/in²
perpendicular to fibers	2.08 × 10⁶ lb/in²
Modulus of Rupture	
parallel to fibers	4,397 lb/in²
perpendicular to fibers	3,176 lb/in²
Shear Strength	1,980 lb/in²
Tensile Strength (parallel to surface)	
Longitudinal	2,089 lb/in²
Transverse	1,381 lb/in²
Compressive Strength	
(14% deformation)	15,386 lb/in²

PHYSICAL PROPERTIES	VALUE
Coefficient of Thermal Conductivity (k)	2.39 Btu·in/hr·ft²·°F
Coefficient of Thermal Movement	
+68°F to 212°F (Expansion)	6.8 × 10⁻⁶ in/in °F
Density Dry	96.0 lbs/ft³
Moisture Content	
65% RH, 68°F	5%
Moisture Movement	
Normal to Saturation	0.015 in/ft
Normal to Dry	0.024 in/ft
Water Vapor Permeance	
4mm	6.94 PERMS
6mm	4.63 PERMS
7.5mm	3.49 PERMS
Water Vapor Transmission	
4mm	11,875 GRAINS/ft²H
6mm	7,923 GRAINS/ft²H
7.5mm	5,972 GRAINS/ft²H
Surface Burning	
Flame Spread	0
Smoke Developed	0
Continuous Maximum Temperature	500°F

MECHANICAL PROPERTIES	VALUE	TEST STANDARD
Modulus of Elasticity		ASTM C-120
parallel to fibers	565,650 lb/in²	
perpendicular to fibers	435,120 lb/in²	
Modulus of Rupture		ASTM D-1037
parallel to fibers	1,595 lb/in²	
perpendicular to fibers	1,015 lb/in²	
Shear Strength		BS-3503
parallel to fibers	1,015 lb/in²	
perpendicular to fibers	725 lb/in²	
Tensile Strength		ASTM C-209
parallel to fibers	652 lb/in²	
perpendicular to fibers	420 lb/in²	
Compressive Strength		ASTM C-170
(14% deformation)	1,885 lb/in²	
Impact Strength	9.2 in lbf/in²	ASTM D 2568

PHYSICAL PROPERTIES	VALUE	TEST STANDARD
Coefficient of Thermal Conductivity (k)	1.179 Btu·in/hr·ft²·°F	ASTM C-518
Coefficient of Thermal Movement		ASTM B 95
+68°F to 212°F (Expansion)	3.84 × 10⁻⁶ in/in °F	
+68°F to -20°F (Shrinkage)	3.88 × 10⁻⁶ in/in °F	
Density, Normal		ASTM D 1037
65% RH, 68°F	68.4 lbs/ft³	
Moisture Content		ASTM D 1037
65% RH, 68°F	3.15%	
Moisture Movement		ASTM D-1037
68°F, 50% RH to Saturation	.008 in/ft	
PH Value		Manufacturer's Data
(25% Slurry)	11	
Water Vapor Permeance, 10mm	10.5 PERMS	ASTM E-96
Water Vapor Transmission, 10mm	18.35 grains/ft²H	ASTM E-96
Surface Burning		ASTM E-84
Flame Spread	0	
Smoke Developed	0	
Continuous Maximum Temperature	550°F	Manufacturer's Data

WIND LOAD

Deflection Data	Uniform Load (PSF)									
	15	20	25	30	35	40	45	50	55	60
Board Thickness	Allowable stud spacing given L/240 maximum deflection (inches) * (panel deflection inches)									
10mm (3/8")	24 (.045)	24 (.046)	24 (.068)	24 (.080)	24 (.081)	16 (.023)	16 (.026)	16 (.028)	16 (.031)	16 (.034)
12mm (1/2")	24 (.029)	24 (.038)	24 (.044)	24 (.052)	24 (.080)	24 (.067)	24 (.075)	24 (.082)	24 (.089)	16 (.019)

3.1 MARKET SURVEY

3.1 Introduction

The purpose of this investigation was to determine the potential viability of marketing a CBPB that would be produced in Alberta. The basic premise being that the board could be produced at a cost that would be competitive with existing similar products. The major question was what particular market would this product fit into and is the demand sufficient to absorb the output of the plant.

The basic approach of the survey was to check a cross section of potential users and determine if they could see a use for the product and in what particular application.

3.2 Methodology

In the brief time available to assess the market potential for CBPB it was believed essential that contact be made directly with potential users or vendors. This resulted in contacting face-to-face as broad a cross section of Alberta business as possible.

The basic methodology involved was to develop a generalized questionnaire which could be utilized with a cross section of potential board buyers. Having done this a direct approach was made to potential purchasers i.e. either vendors or fabricators to assess their potential interest in the board.

3.2.1 Markets Approached

The markets initially determined to be most receptive to this type of product were:

1. Relocatable buildings, for example portable office buildings, school houses, lunch houses etc.
2. Agricultural buildings, for example pole barns, granaries, hay sheds.
3. Industrial & commercial buildings, for example small factory & warehouse buildings, strip shopping malls, etc.

3.2.2 Personal Interviews

Within these categories plus certain others that developed from the visits, personal contact was made with twenty (20) companies. The results of the interviews are presented in Appendix C. Fourteen (14) compaines disclosed annual consumption of

different board products with currently paid prices. Table 3 shows only those products which CBPB can replace at prices against which CBPB is competitive. The interviews consisted of describing the product, of a sample, then discussing possible applications for the given situation. In each case questions, of course, were asked as to the type of business and need for this type of product. A basic profile was developed for each outlet.

3.2.3 Relocatable Buildings

The market often turns to be not the one originally anticipated. While relocatable housing still remains a possibility, it would seem that the board has certain drawbacks that would make it unattractive for this application. In particular, it may be too heavy for a product that has to be transported often over hundreds of miles. The additional weight then becomes a cost factor.

Having approached the largest in the business, ATCO, and getting a somewhat critical response it was decided not to pursue this avenue at this time. It is, however, possible that one or another manufacturer could see a need for this product but this would have to be determined at some future time.

3.2.4 Agriculture Buildings

The agricultural market seems to offer a good deal more potential in that construction goes on a continuing basis. While the grain farmers are cutting back, the hog, poultry and beef farmers are not suffering. As a result, construction in pole barns, hog and poultry barns, machine sheds, granaries, etc. continues at a reasonable pace.

CBPB can find application basically wherever treated lumber and treated plywood is used. This is in the lower section of pole barns, in the interior and exterior of hay and chicken barns where cleanliness is desired and water is used for flushing the buildings, also in the construction of various buildings where steel is normally used, for example barns, machine sheds and granaries.

In these categories and in dealing with cost conscious farmers, price will be a critical factor. That means that the price of a sheet of CBPB will have to be in the same range as the price of treated plywood.

3.2.5 Industrial and Commercial Buildings

This category also seems to offer strong possibilities for substantial sales,

TABLE 3

Disclosed Annual Volumes And Prices

Company	Type of Board	Volume Sq. Ft.	Price Sq. Ft.
Jager	OSB PT Plywood	7,000,000	
	PT Plywood	208,000	0.94
Champagne	1/2" Wonderboard	25,000	2.15
Home All	Coolcrate		8.75
	Wonderboard		2.24
Sabo Bros.	Metal	100,000	1.12
PCL	Metal	250,000	1.05
	PT Plywood	100,000	1.00
	Wonderboard		2.30
	1/4" Asbestos	250,000	1.00
Chandos	Wonderboard		2.32
	Asbestos	250,000	1.25
Intex	Wonderboard	50,000	2.46
	Concrete	50,000	2.50
	Metal	400,000	1.00
Nelson	5/8" Plywood	96,000	0.85
	1/2" Wonderboard	20,000	1.60
	3/4" Particleboard	90,000	0.73
	Concrete Formply	100,000	0.80
Cana	Metal	300,000	1.20
	1/2" Plywood	100,000	0.95
	Steel	75,000	0.95
	Aluminum	10,000	0.90
	Steel Doors	50,000	0.92
	Wonderboard	2,000	2.32
	3/4" Plywood	160,000	0.78
Windsor	5/8" Plywood	280,000	0.72
	Flooring	720,000	0.71
	1/2" PT Plywood	96,000	0.83
Calgary Co-Op	Metal	76,000	4.50
	Wonderboard	1,750	2.45
	5/8" PT Plywood	1,800	1.10
Revelstoke	5/8" Plywood	442,000	0.78
	Wonderboard	3,600	2.13
	5/8" PT Plywood	100,000	0.84
Stuart Olson	Metal	1,000,000	1.10
	3/8" Exterior Finished Plywood	1,300,000	4.00
	Metal Cladding	750,000	3.00
	3/8" Plywood	1,650,000	0.75
	Wonderboard	50,000	3.12
	Pt Plywood	40,000	0.90
	Asbestos	3,200	1.25
All Wood	5/8" PT Plywood	480,000	0.90
14 Companies		16,780,000	

Current selling prices of cement-based panelboards available in Canada are shown in Appendix F. (Ed.)

particularly in the following applications:

- siding on factories, warehouses, strip malls
- for the parapet on balconies on apartment and condominium buildings
- for the interior walls of bathrooms, saunas, and other wet rooms
- for subfloors in basements
- for flat or bonded roofs
- for all applications involving fire walls, doors, ceilings
- for sight and sound barriers
- for wood I beam constructions
- in a whole range of oil field applications

3.3 Market Assessment

As indicated in paragraph 3.2.2., fourteen of the twenty companies interviewed disclosed a total of almost 17 million square feet of boards which can be replaced by CBPB based on its qualities and depending on its selling price. We have, therefore, included in Table 3 only products where the price is over our projected price of $ 25.00 per 4' x 8' sheet less 5 + 5 % discount i.e. $ 0.70 per square foot. It is highly likely, due to better performance at a lower price, that the new plant can capture at least half of this volume i.e. 8,500,000 square feet.

The overall market potential for a product as specialized as CBPB is extremely difficult to quantify particularly in the time allotted. If it was a standard board such as waferboard or plywood then we could just take prior years figures, analyze our costs, assess our transportation costs, decide on a territory versus the competition and come up with a market share.

In the case of CBPB a new product is being introduced for which a market will have to be carved out. A good deal of effort will be required to obtain the various approvals, then considerable promotion and publicity will be required to launch the product. This can run parallel to the reconditioning, re-erection and commissioning of the plant.

A look at housing starts will be useful;

	1986	1987 to July
Alberta	8462	4451
B.C.	20687	13129
Saskatchewan	5510	2586
Manitoba	7699	3977
	42358	24143

A certain percentage of the plant output could be sold to be used in bathrooms and saunas. Our discussions would indicate that the more expensive houses are the more likely candidates so let us assume that 33 1/3% are candidates or 14,000 houses forWestern Canada, 2 bathrooms each, with an average of 750 sq. ft. of board for a total of 10,500,000 sq. ft. Let us further estimate that CBPB could capture 10% of this market initially, moving up to 20% and then 30%, or approximately 1,050,000 sq. ft. the first year 2,100,000 the second and 3,150,000 sq. ft. the third.

While the overall figures are not high in relation to the eventual output of the plant of 20,000,000 sq. ft. it is also a very minor market niche for this product. The key reasons for zeroing in on this particular market is that the statistics are readily available compared to trying to define the much larger potential uses such as farm buildings, industrial roofing or fire walls.

With farm buildings it is even more difficult to come up with meaningful statistics as to potential volume of sales. The figures we were able to obtain show the following:

1986 Alberta

57,000 farmers, of which
30,000 cattle-related
17,000 livestock the only source

Supplying them:

206 building supply stores total
$ 388 million in sales
86 stores in major centers
$ 258 million in sales
120 stores in small communities
$ 130 million in sales

Total capital investment in farm buildings, excluding houses and fencing, is $65 million with an average annual construction cost of $ 10 million.

It is difficult to determine an exact market share for CBPB from these figures. What we established, though, is that:

- Jager Construction is interested in the total plant output if current board tests prove positive.
- Several major distributors including Home All, Revelstoke, McMillan Bloedel and Sauder Industries are all interested in taking a portion of the output.
- Construction companies, that do work in the oil fields, show extreme interest.
- There are several market niches into which this product can fit. What will be needed is time and money to open them up.

3.4 Market Penetration

In approaching a market as splintered as this, considerable time and thought should be given to first identifying each select market potential and then determining how to approach it.

This should be done in the following manner:

3.4.1 Step I

3.4.1.1 Assemble all technical data presently available and have it verified by a suitable authority i.e. Alberta Research Council, Forintek.

3.4.1.2 Commission such an authority to have tests made and document the results.

3.4.1.3 Obtain product approval or, if too costly have the testing authority state that in all likelihood it will be approved for fireproof, sound proof, water proof etc. applications.

3.4.2 Step II

3.4.2.1 Prepare promotional material i.e. brochures, videos, and samples.

3.4.2.2 Approach major potential distributors e.g. Revelstoke, Home All, McMillan Bloedel, Co-Op, Sauder, etc. regarding their possible interest and what volume they would be interested in committing to before the plant is in operation.

3.4.2.3 Arrange for several board samples to be made available for each distributor to test the board in the types of application where they see it has the most advantage.

3.4.2.4 Assist the distributor and the retailer in identifying potential customers based on the in-depth identification process already carried out.

3.4.2.5 Follow up at the retail level to assist and guide the actual installer in the "how to's" of installing the board.

3.4.2.6 When all this is done and the customer is satisfied, go back to the major distributors, point out the volume potential and get them to commit to take a guaranteed volume of board per year.

3.5 Conclusions

What the market survey, however brief, did disclose is that there is a potential need for this type of product and in a far greater volume than the plant will be capable of producing. The total market for panel boards could not be established within the framework of this study.

3.5.1. There are all sorts of speciality market niches ranging from treated wood foundations to balcony parapets to I beams. For example, the treated wood foundations market penetration seems to have reached a maximum. Buyers who are now skeptical that wood has the longevity of concrete, despite the proven advantages of wood, seem to accept CBPB.

The thinking appears to be by many in the trade that it is not the type of construction that turns people off so much as that the outside wall cover is made of plywood.

Interviews with installers and buyers therefore, indicated that CBPB could be the product that breaks the log jam on increasing market penetration. It has the look and feel of concrete that might be all it takes to move up to the next level of usage of this type of basement construction.

Here is a prime example of the need to do some specific test marketing before making the commitment to put up the plant.

The potential in treated wood foundations could be significant. It is estimated by Jager that 2500 such wood basements are constructed annually in Western Canada and this could be doubled to 5,000 with the introduction of CBPB, thus the potential could be in the range of 5 -6,000,000 sq. ft. of 5/8" board annually.

3.5.2 Possibly one of the more important aspects of cement bonded particleboard that the market survey most definitely points to is that this product is not a commodity product. It cannot simple be thrown onto the market as is waferboard or lumber or plywood. There will be a need, as stated earlier, to further identify specific market niches and even geographic areas.

3.5.3 Once there is such a plant in Canada and because many products that CBPB will replace are very expensive e.g. Wonderboard (at three times the price) the product will be able to stand a fair amount of transportation cost.

This means also that not only is Eastern Canada a potential target but certainly much of the North Western United States.

In fact, should a decision be made to pursue a more in-depth market analysis as

described above, then it should be conducted also in places like Salt Lake City, Denever, and Seattle. To Ligna's knowledge no such plant exists in the Western U.S.A. so potential buyers there have not been exposed to the product yet.

As in Canada, however, the product will need to be promoted and marketed in a professional manner. An in-depth study defining all the above markets will cost approximately $ 50,000 depending on the scope of work.

3.6 Recommendations

3.6.1 The market opportunities for this product must be clearly identified and a sales strategy developed to sell each specialized user.

3.6.2 The price must be in line with products that can or are being used in the application now ranging from, $ 30.00 per 4' x 8' sheet for treated spruce plywood to $ 75.00 for the Wonderboard.

3.6.3 A company starting in this business needs to allow considerable promotion funds to be used in introducing the product to the market. Ligna included $ 2,500,000 in the financial analysis for this purpose just in the first year.

3.6.4 Whoever is to start in this business should do considerable preliminary market development preferably before the decision is made to proceed with the plant. This means assembling promotional material, obtaining a quantity of 4' x 8' samples and putting them out in the market place, as Ligna is currently doing with Jager Industries.

3.6.5 A major portion of the output of the plant should be contracted for before a decision is made to proceed. The initial output of the plant could be based on approximately 15,000,000 sq. ft./year increasing to 20,000,000 per year by the fifth year. This would make the first year operation already profitable with a reasonable increase in successive years.

4. FINANCIAL ANALYSIS

4.1 Introduction

The financial projections for both the Fulgurit and a new Bison plant as well as both the Cochrane and Edmonton locations were based on Fulgurit's actual German costing presented in Appendix "E". Included with Fulgurit's costing analysis is an English translation. Assuming the accuracy of Fulgurit's costing of the CBPB we proceeded to convert from metric to imperial measurement. Pricing in Canadian currency for materials as well as labour was implemented in these projections. In the following pages we detailed our cost breakdown which preceeds the actual projections. We assumed a high cost base with a low selling point to allow the most realistic financial outlook. Operating costs for both plants are the same with the only difference being the capital costs. See Tables 4-22.

4.2. Assumptions

We assumed that the federal government would grant non-refundable monies up to 17.5% of capital cost to either of these locations. The federal grant is payable upon proof of payment on capital expenditures. Our research indicates that at this time the province will only contribute loan guarantees toward capital purchases. Interest rates varied depending on the use of the monies borrowed. The building loan is at a rate of 12 % with the loan amortized over fifteen years. The equipment loan is at 13 % amortized over ten years. The short term loan is at a rate of 12 % with capital paid down as the cash flow permits. Accounts receivable were financed at 70 % of book value at a rate of 12 % per annum.

The opening balance sheet for both scenarios assumed approval from the federal level, and allowed six months of site preparation, construction and then implementation for production. Therefore there is six months accrued interest as a payable as well as the federal grant being treated as income rather than capitalized.

The cost of proceeding with the 'Fulgurit' scenario without such a grant is outlined in Appendix G. (Ed.)

TABLE 4

Cement Bonded Particle Board
Cost per Ton and Cost per Sheet Of Finished Product
Cochrane or Edmonton Location
Fulgurit or Bison Plant

Production and revenue data with specifics to evaluate market and product cost relations.
Daily capacity 60 Imperial tons = 60,000 sq. ft. (5,400 m^2). 1 Ton = 28 sheets.
1 Sheet = 4'x 8' (1.2192 m x 2.4384 m). Total of 60 employees for 3 shifts.

Description	Revenue/Cost Per Ton	Revenue/Cost Per Sheet	Additional Data
Gross List Price	$ 700.00	$ 25.00	3/8" (10 mm) thickness
Dealer discount (5%)	35.00	1.25	
Cash discount (2.5%)	35.00	1.25	
Net Price	630.00	22.50	Western Canada
Wood	4.80	.17	640 lbs (288 kg) per ton
Cement (*)	82.00	2.93	1,303 lbs (587 kg) per ton
Additives	2.40	.09	57 lbs (26 kg) per ton
Total raw materials	89.20	3.19	
Electricity	6.80	.24	162 kwh per ton
Gas	5.28	.19	1,300 cu.ft.(43 m^3) per ton
Water	1.65	.06	10 cu.ft.(324 kg) per ton
Total energy costs	13.73	.49	
Maintenance	19.00	.68	Tools, repairs & materials.
Salaries	158.00	5.64	32 production workers
Pallets	4.50	.16	
Losses	.50	.02	Raw material
Total Direct Costs	284.93	10.18	All above costs.
Gross operating margin	345.07	12.32	After above expenses.
Salaries	96.00	3.43	28 Supervisory/administration
Insurance-taxes-fees	19.00	.68	
Bad debts	8.00	.29	Estimation
Heating	2.00	.07	Only in winter
Total Fixed Costs	125.00	4.47	Fixed costs.
Subtotal	$ 220.07	$ 7.85	From this amount deduct 1) General expenses 2) Interest & depreciation 3) Advertising & promotion 4) Etc.

(*) Cochrane location;
- Cost of cement per finished ton decreases by $4.80.
- Cost of cement per finished sheet decreases by $.17.

TABLE 8

Cement Bonded Particleboard Plant
Capital Costs
Cochrane or Edmonton Location
Fulgurit or Bison Plant

Description	Fulgurit Plant	Bison Plant
Building	$ 2,160,000	$ 2,160,000
Land (1)	250,000	250,000
Machinery	2,200,000 (2)	7,470,000 (3)
Shipping-Insurance	750,000	750,000
Mobile Equipment	(Included in machinery costs)	475,000
Dust Collecting	(Included in machinery costs)	260,000
Installation	750,000	1,000,000
Engineering	300,000	500,000
Contingencies (5%)	320,000	640,000
Total Capital Costs	$ 6,730,000	$ 13,505,000

(1) Based on Cochrane site. Edmonton location is less by $10,000.

(2) Includes $200,000 for outside purchase of electrical motors etc.

(3) Includes electrical motors direct from Bison.

TABLE 6

Cement Bonded Particleboard Plant
Labour Requirements
Cochrane or Edmonton Location
Fulgurit or Bison Plant

Job Description	Shifts I	Shifts II	Shifts III	Maintenance & Warehouse	Annual Cost Individual	Annual Cost Total
Shift supervisor	1	1	1	-	$ 37,500	$ 112,500
Mechanical electrician	1	1	1	-	31,000	93,000
Flaker	1	1	1	-	25,000	75,000
Mixer	1	1	1	-	25,000	75,000
Machine operator	1	1	1	-	25,000	75,000
Press operator	1	1	1	-	25,000	75,000
Forklift operator	1	1	1	-	21,000	63,000
Climate chamber operator	2	2	2	-	25,000	150,000
Trim saw operator	-	-	-	7	25,000	175,000
Trim saw supervisor	-	-	-	1	37,500	37,500
Tenoner operator	2	2	2	-	25,000	150,000
Grinder	-	-	-	1	25,000	25,000
Electrician	-	-	-	1	31,000	31,000
Forklift operator	-	-	-	3	21,000	63,000
Woodyard worker	-	-	-	1	14,000	14,000
Inspector	-	-	-	1	37,500	37,500
Cleaning personnel	-	-	-	1	14,000	14,000
	11 +	11 +	11 +	17= 50	$ 440,500	$ 1,265,500
+12% sick leave holidays				+4	+ 53,000	+ 152,000
				54	493,500	1,417,500
+ office staff				+6	+ 18,000	+ 108,000
TOTAL				60	$ 511,000	$ 1,525,500

TABLE 7

PROJECTED OPENING BALANCE SHEET
AFTER CONSTRUCTION
For A Proposed Fulgurit Plant

ASSETS		
Current Assets		
Cash	$ 529,750	
Accounts Receivable Grant	1,177,750	
Total Current Assets		$ 1,707,500
Depreciable Assets		
Machinery & Equipment	4,320,000	
Building	2,160,000	
Total Depreciable Assets		6,480,000
Other Assets		
Land	250,000	
Total Other Assets		250,000
TOTAL ASSETS		$ 8,437,500
LIABILITIES		
Current Liabilities		
Accrued Interest	$ 70,665	
Short Term Note Payable	1,177,750	
Total Current Liabilities		$ 1,248,415
Long Term Liabilities		
Mortgage on Building	1,807,500	
Mortgage on Equipment	2,592,000	
Total Long Term Liabilities		4,399,500
TOTAL LIABILITIES		5,647,915
CAPITAL		
Common Stock-NPV	$ 1,682,500	
Retained Earnings	1,107,085	
Total Capital		2,789,585
TOTAL LIABILITIES & CAPITAL		$ 8,437,500

TABLE 8

FIVE YEAR PROJECTED BALANCE SHEETS
Based on twelve month periods

For A Proposed Bison Plant

ASSETS	Yr1	Yr2	Yr3	Yr4	Yr5
Current Assets					
Chequing Account	$ 18,541	$ 142,521	$ 796,041	$ 2,038,812	$ 4,026,014
Accounts Receivable	1,957,500	2,652,885	3,375,349	3,924,539	4,437,966
Inventory - Finished Goods	293,000	301,790	322,915	336,832	369,415
- Work in Progress	20,828	21,453	22,955	23,873	26,260
- Raw Materials	4,955	5,104	5,461	5,679	6,247
Total Current Assets	2,294,824	3,123,753	4,522,721	6,328,736	8,865,902
Depreciable Assets					
Machinery & Equipment	4,320,000	4,320,000	4,320,000	4,320,000	4,320,000
Building	2,160,000	2,160,000	2,160,000	2,160,000	2,160,000
Land	250,000	250,000	250,000	250,000	250,000
Less Depreciation	-972,000	-1,755,800	-2,416,230	-2,951,194	-3,393,056
Total Depreicable Assets	5,758,000	4,964,200	4,313,770	3,778,806	3,336,945
TOTAL ASSETS	$ 8,052,824	$ 8,087,953	$ 8,836,491	$ 10,107,541	$ 12,202,847
LIABILITIES					
Current Liabilities					
Accounts Payable	$ 318,784	$ 328,350	$ 351,334	$ 365,387	$ 401,925
Line of Credit	1,370,250	1,398,600	1,512,000	1,571,850	1,689,187
Total Current Liabilities	1,689,034	1,726,950	1,863,334	1,937,237	2,091,112
Long Term Liabilities					
Mortgage on Building	1,761,612	1,709,907	1,651,645	1,585,993	1,512,018
Mortgage on Equipment	2,456,669	2,302,659	2,127,387	1,927,923	1,700,927
Total Long Term Liabilities	4,218,281	4,012,566	3,779,032	3,513,916	3,212,942
TOTAL LIABILITIES	5,907,315	5,739,516	5,642,366	5,451,153	5,304,054
Capital					
Common Stock - NPV	1,682,500	1,682,500	1,682,500	1,682,500	1,682,500
Retained Earning	463,009	665,937	1,511,625	2,973,888	5,216,293
Total Capital	2,145,509	2,348,437	3,194,125	4,656,388	6,898,793
TOTAL LIABILITIES & EQUITY	$ 8,052,824	$ 8,087,953	$ 8,836,491	$ 10,107,541	$ 12,202,847

TABLE 9

FIVE YEAR PROJECTED INCOME & EXPENSE STATEMENTS
Based on twelve month periods

For A Proposed Fulgurit Plant

	Yr1	Yr2	Yr3	Yr4	Yr5
Operating Revenue					
Sales	$ 11,718,750	$ 13,281,250	$ 14,062,500	$ 14,843,750	$ 15,625,000
Less Discounts	1,171,875	1,328,125	1,406,500	1,484,375	1,562,500
Effective Gross Operating Income	10,546,875	11,953,125	12,656,250	13,359,938	14,062,500
Cost of Goods Sold	1,504,688	1,705,313	1,805,625	1,905,938	2,006,250
Gross Operating Margin	9,042,187	10,247,812	10,850,625	11,453,437	12,056,250
Marketing & Promotion	2,875,000	2,400,000	2,160,000	1,920,000	1,500,000
Utilities (Energy)	234,375	265,625	281,250	296,875	312,500
Maintenance	318,750	361,250	382,500	403,750	425,000
Direct Labour & Benefits	2,643,750	2,996,250	3,172,500	3,348,750	3,525,000
Total Direct Expenses	5,771,875	6,023,125	5,996,250	5,969,375	5,762,500
Gross Operating Profit	3,270,312	4,224,687	4,854,375	5,484,062	6,293,750
Administration & Office Salaries	1,607,813	1,822,188	1,929,375	2,036,563	2,143,750
Legal-Taxes-Insurance	318,744	361,248	382,500	403,740	425,004
Depreciation	972,000	793,800	650,430	534,964	441,861
Misc.	316,406	358,594	379,688	400,781	421,875
Interest Short & Long Term	699,425	685,929	666,694	645,751	618,859
Total General & Administrative Expense	3,914,388	4,021,758	4,008,687	4,021,799	4,051,349
OPERATING INCOME/DEFICIT BEFORE TAXES	-644,076	202,928	845,688	1,462,263	2,242,405

TABLE 10

FULGRIT PLANT - Projected Cash Flow Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Beginning Balance	529750	515254	219283	118391	58352	23822	11976	8421	8294	5259	2825	1798	529750
Cash receipts	1571500	472500	1094063	1289250	1389375	1539000	1577250	1622250	1644750	1644750	1652625	1652625	17149938
Cash on Hand	2101250	987754	1313345	1407641	1447727	1562822	1589226	1630671	1653044	1650009	1655450	1654423	17679688
APPLICATION OF FUNDS													
Raw Materials	80250	96300	108338	125190	128400	134820	138030	138030	138030	138030	139635	139635	1504688
Energy	12500	15000	16875	19500	20000	21000	21500	21500	21500	21500	21750	21750	234375
Maintenance	17000	20400	22950	26520	27200	28560	29240	29240	29240	29240	29580	29580	318750
Direct Labour	141000	169200	190350	219960	225600	236880	242520	242520	242520	242520	245340	245340	2643750
Marketing & Promo.	250000	250000	225000	225000	225000	200000	200000	200000	200000	200000	200000	200000	2575000
Admin & Office Sal.	85750	102900	115763	133770	137200	144060	147490	147490	147490	147490	149205	149205	1607813
Legal/Tax/Ins.	26562	26562	26562	26562	26562	26562	26562	26562	26562	26562	26562	26562	318744
Loan Pymt (Building)	3618	3654	3691	3728	3765	3803	3841	3879	3918	3957	3997	4037	45888
Loan Pymt (Equip)	10621	10736	10853	10970	11089	11209	11331	11453	11578	11703	11830	11958	135331
Loan Pymts (ST)	825000	0	0	0	0	40000	40000	50000	60000	60000	60000	42750	1177750
Loan Pymts (LC)	0	0	393750	472500	531563	614250	630000	661500	677250	677250	677250	677250	6012563
Interest (Building)	18075	18039	18002	17965	17928	17890	17852	17814	17775	17736	17696	17657	214429
Interest (Equip)	28080	27966	27849	27731	27612	27492	27371	27248	27124	26998	26872	26743	329085
Interest (ST)	70665	3528	3528	3528	3528	3528	3128	2728	2228	1628	1028	428	99473
Interest (LC)	0	3938	8663	10041	11458	12443	12915	13388	13545	13545	13545	13624	127103
Misc.	16875	20250	22781	26325	27000	28350	29025	29025	29025	29025	29363	29363	316406
TOTAL DISBURSEMENTS	1585996	768472	1194954	1349290	1423905	1550847	1580805	1622377	1647785	1647184	1653653	1635881	17661146
Cash on Hand	2101250	987754	1313345	1407641	1447727	1562822	1589226	1630671	1653044	1650009	1655450	1654423	17679688
Disbursements	1585996	768472	1194954	1349290	1423905	1550847	1580805	1622377	1647785	1647184	1653653	1635881	17661146
Ending Balance	515254	219283	118391	58352	23822	11976	8421	8294	5259	2825	1798	18541	18541
Sales	562500	675000	759375	877500	900000	945000	967500	967500	967500	967500	978750	978750	10546875
# of Sheets	25000	30000	33750	39000	40000	42000	43000	43000	43000	43000	43500	43500	468750
SOURCE OF FUNDS													
Federal Grants	1177750	0	0	0	0	0	0	0	0	0	0	0	1177750
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	393750	472500	531563	614250	630000	661500	677250	677250	677250	677250	685125	685125	7382813
Accounts Rec. Proceeds	0	0	562500	675000	759375	877500	900000	945000	967500	967500	967500	967500	8589375
Total	1571500	472500	1094063	1289250	1389375	1539000	1577250	1622250	1644750	1644750	1652625	1652625	17149938

TABLE 11

FULGRIT PLANT - Projected Cash Flow

Month	13	14	15	16	17	18	19	20	21	22	23	24	Total
Beginning Balance	18541	19897	21619	25013	29840	35962	42608	59233	75858	92483	109109	125734	18541
Cash receipts	1609088	1613025	1622250	1629113	1634400	1636515	1646494	1646494	1646494	1646494	1646494	1648069	19624928
Cash on Hand	1627629	1632922	1643869	1654126	1664240	1672477	1689102	1705726	1722352	1738977	1755603	1773802	19643469
APPLICATION OF FUNDS													
Raw Materials	140438	141240	142043	142364	142364	142364	142364	142364	142364	142364	142364	142685	1705313
Energy	21875	22000	22125	22175	22175	22175	22175	22175	22175	22175	22175	22225	265625
Maintenance	29750	29920	30090	30158	30158	30158	30158	30158	30158	30158	30158	30226	361250
Direct Labour	246750	248160	249570	250134	250134	250134	250134	250134	250134	250134	250134	250698	2996250
Marketing & Promo.	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000	2400000
Admin & Office Sal.	150063	150920	151778	152121	152121	152121	152121	152121	152121	152121	152121	152464	1822188
Legal/Tax/Ins.	30104	30104	30104	30104	30104	30104	30104	30104	30104	30104	30104	30104	361248
Loan Pymt (Building)	4077	4118	4159	4200	4242	4285	4328	4371	4415	4459	4503	4548	51705
Loan Pymt (Equip)	12087	12216	12351	12485	12620	12757	12895	13034	13176	13318	13463	13608	154010
Loan Pymts (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Pymts (LC)	686125	685125	689063	693000	696938	698513	698513	698513	698513	698513	698513	698513	8338838
Interest (Building)	17616	17575	17534	17493	17451	17408	17365	17322	17278	17234	17190	17145	208611
Interest (Equip)	26614	26483	26351	26217	26082	25945	25807	25667	25526	25383	25239	25093	310407
Interest (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest (LC)	13703	13742	13821	13899	13955	13970	13970	13970	13970	13970	13970	13970	166911
Misc.	29531	29700	29869	29936	29936	29936	29936	29936	29936	29936	29936	30004	358594
TOTAL DISBURSEMENTS	1607732	1611303	1618856	1624266	1628278	1629869	1629869	1629868	1629869	1629868	1629869	1631282	19500948
Cash on Hand	1627629	1632922	1643869	1654126	1664240	1672477	1689102	1705726	1722352	1738977	1755603	1773802	19643469
Disbursements	1607732	1611303	1618856	1624266	1628278	1629869	1629869	1629868	1629869	1629868	1629869	1631282	19500948
Ending Balance	19897	21619	25013	29840	35962	42608	59233	75858	92483	109109	125734	142521	142521
Sales	984375	990000	995625	997875	997875	997875	997875	997875	997875	997875	997875	1000125	11953125
# of Sheets	43750	44000	44250	44350	44350	44350	44350	44350	44350	44350	44350	44450	531250
SOURCE OF FUNDS													
Federal Grants	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	689063	693000	696938	698513	698513	698513	698513	698513	698513	698513	698513	700088	8367188
Accounts Rec. Proceeds	920025	920025	925313	930600	935888	938003	947981	947981	947981	947981	947981	947981	11257740
Total	1609088	1613025	1622250	1629113	1634400	1636515	1646494	1646494	1646494	1646494	1646494	1648069	19624928

TABLE 12

FULGRIT PLANT - Projected Cash Flow

Month	25	26	27	28	29	30	31	32	33	34	35	36	Total
Beginning Balance	142521	177521	213553	250748	290676	335798	385307	449855	516272	584388	654179	725110	142521
Cash receipts	1648069	1654931	1666744	1684969	1712813	1732781	1763325	1773450	1782000	1788480	1792800	1792800	20793161
Cash on Hand	1790590	1832453	1880297	1935717	2003489	2068579	2148632	2223306	2298272	2372868	2446979	2517910	20935682
APPLICATION OF FUNDS													
Raw Materials	142685	143648	146085	148463	150870	151673	152475	153438	154080	154080	154080	154080	1805625
Energy	22225	22375	22750	23125	23500	23625	23750	23900	24000	24000	24000	24000	281250
Maintenance	30226	30430	30940	31450	31960	32130	32300	32504	32640	32640	32640	32640	382500
Direct Labour	260698	252390	256620	260850	265080	266490	267900	269592	270720	270720	270720	270720	3172500
Marketing & Promo.	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	2160000
Admin & Office Sal.	152464	153493	156065	158638	161210	162068	162925	163954	164640	164640	164640	164640	1929375
Legal/Tax/Ins.	31875	31875	31875	31875	31875	31875	31875	31875	31875	31875	31875	31875	382500
Loan Pymt (Building)	4594	4640	4686	4733	4780	4828	4877	4925	4975	5024	5075	5125	58262
Loan Pymt (Equip)	13756	13905	14056	14208	14362	14517	14675	14834	14994	15157	15321	15487	175272
Loan Pymts (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Pymts (LC)	698513	700088	700088	704813	716625	728438	740250	744188	748125	752850	756000	756000	8745975
Interest (Building)	17099	17053	17007	16960	16913	16865	16816	16768	16718	16669	16618	16568	202054
Interest (Equip)	24945	24796	24646	24494	24340	24184	24027	23868	23707	23545	23380	23214	289146
Interest (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest (LC)	13986	14002	14049	14214	14481	14687	14844	14923	15010	15089	15120	15120	175494
Misc.	30004	30206	30713	31219	31725	31894	32063	32265	32400	32400	32400	32400	379688
TOTAL DISBURSEMENTS	1613068	1618900	1629549	1645041	1667691	1683272	1698777	1707034	1713884	1718689	1721869	1721869	20139641
Cash on Hand	1790590	1832453	1880297	1935717	2003489	2068579	2148632	2223306	2298272	2372868	2446979	2517910	20935682
Disbursements	1613068	1618900	1629549	1645041	1667691	1683272	1698777	1707034	1713884	1718689	1721869	1721869	20139641
Ending Balance	177521	213553	250748	290676	335798	385307	449855	516272	584388	654179	725110	796041	796041
Sales	1000125	1006875	1023750	1040625	1057500	1063125	1068750	1078500	1080000	1080000	1080000	1080000	12656250
# of Sheets	44450	44750	45500	46250	47000	47250	47500	47800	48000	48000	48000	48000	562500
SOURCE OF FUNDS													
Federal Grants	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	700088	704813	716625	728438	740250	744188	748125	752850	756000	756000	756000	756000	8859375
Accounts Rec. Proceeds	947981	950119	950119	956531	972563	988594	1015200	1020600	1026000	1032480	1036800	1036800	11933786
Total	1648069	1654931	1666744	1684969	1712813	1732781	1763325	1773450	1782000	1788480	1792800	1792800	20793161

TABLE 13

FULGURIT PLANT - Projected Cash Flow

Month	37	38	39	40	41	42	43	44	45	46	47	48	Total
Beginning Balance	796041	885201	975170	1065866	1160138	1257420	1357848	1470269	1583874	1697479	1811163	1924840	796041
Cash receipts	1792600	1800675	1808550	1827225	1840388	1854338	1868749	1873114	1873114	1873901	1873901	1874993	22161746
Cash on Hand	2588641	2685876	2783720	2893091	3000526	3111758	3226597	3343383	3456988	3571380	3685064	3799832	22957788
APPLICATION OF FUNDS													
Raw Materials	154080	155685	157290	158895	159377	160019	160019	160019	160019	160179	160179	160179	1905938
Energy	24000	24250	24500	24750	24825	24925	24925	24925	24925	24950	24950	24950	296875
Maintenance	32640	32980	33320	33660	33762	33898	33898	33898	33898	33932	33932	33932	403750
Direct Labour	270720	273540	276360	279180	280026	281154	281154	281154	281154	281436	281436	281436	3348750
Marketing & Promo.	160000	160000	160000	160000	160000	160000	160000	160000	160000	160000	160000	160000	1920000
Admin & Office Sal.	164640	166366	168070	169785	170300	170985	170986	170986	170986	171157	171157	171157	2036563
Legal/Tax/Ins.	33645	33645	33645	33645	33645	33645	33645	33645	33645	33645	33645	33645	403740
Loan Pymt (Building)	5177	5228	5281	5333	5387	5441	5495	5550	5605	5662	5718	5775	65652
Loan Pymt (Equip)	15655	15824	15996	16169	16344	16521	16700	16881	17064	17249	17436	17625	199464
Loan Pymts (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Pymts (LC)	756000	756000	756000	763875	771750	779625	781988	785138	785138	785138	785138	785925	9291713
Interest (Building)	16516	16465	16412	16360	16306	16252	16198	16143	16088	16031	15975	15918	194664
Interest (Equip)	23047	22877	22706	22532	22357	22180	22001	21820	21637	21453	21266	21077	264953
Interest (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest (LC)	15120	15120	15199	15356	15514	15616	15671	15703	15703	15703	15711	15719	186134
Misc.	32600	32738	33075	33413	33751	33649	33649	33649	33649	33683	33683	33683	400781
TOTAL DISBURSEMENTS	1703640	1710707	1717854	1732953	1743106	1753910	1756328	1759509	1759509	1760217	1760225	1761020	20918975
Cash on Hand	2588641	2685876	2783720	2893091	3000526	3111758	3226597	3343383	3456988	3571380	3685064	3799832	22957788
Disbursements	1703640	1710707	1717854	1732953	1743106	1753910	1756328	1759509	1759509	1760217	1760225	1761020	20918975
Ending Balance	885201	975170	1065866	1160138	1257420	1357848	1470269	1583874	1697479	1811163	1924840	2038812	2038812
Sales	1080000	1091250	1102500	1113750	1117125	1121625	1121625	1121625	1121625	1122750	1122750	1122750	13359375
# of Sheets	48000	48500	49000	49500	49650	49850	49850	49850	49850	49900	49900	49900	593750
SOURCE OF FUNDS													
Federal Grants	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	756000	763875	771750	779625	781988	785138	785138	785138	785138	785925	785925	785925	9351563
Accounts Rec. Proceeds	1036800	1036800	1036800	1047600	1058400	1069200	1083611	1087976	1087976	1087976	1089068	1089068	12810184
Total	1792800	1800675	1808550	1827225	1840388	1854338	1868749	1873114	1873114	1873901	1873901	1874993	22161746

TABLE 14

FULGRIT PLANT - Projected Cash Flow

Month	49	50	51	52	53	54	55	56	57	58	59	60	Total
Beginning Balance	2038812	2186013	2333779	2482054	2633396	2787919	2946572	3121729	3298787	3477744	3658600	3841357	2038812
Cash receipts	1874993	1880505	1886018	1903894	1923345	1941469	1973475	1982925	1992375	2001825	2011275	2020725	23392823
Cash on Hand	3913805	4066518	4219796	4385948	4556741	4729387	4920047	5104654	5291162	5479569	5669875	5862082	25431635
APPLICATION OF FUNDS													
Raw Materials	160179	161303	162426	164513	166920	167723	168525	169328	170130	170933	171735	172538	2006250
Energy	24950	25125	25300	25625	26000	26125	26250	26375	26500	26625	26750	26875	312500
Maintenance	33932	34170	34408	34850	35360	35530	35700	35870	36040	36210	36380	36550	425000
Direct Labour	281436	283410	285384	289050	293280	294690	296100	297510	298920	300330	301740	303150	3525000
Marketing & Promo.	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000	1500000
Admin & Office Sal.	171157	172358	173558	175788	178360	179218	180075	180933	181790	182648	183505	184363	2143750
Legal/Tax/Ins.	35417	35417	35417	35417	35417	35417	35417	35417	35417	35417	35417	35417	425004
Loan Pymt (Building)	5833	5891	5950	6010	6070	6131	6192	6254	6316	6380	6443	6508	73978
Loan Pymt (Equip)	17816	18009	18204	18401	18600	18802	19005	19211	19419	19630	19842	20057	226996
Loan Pymts (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Pymts (LC)	785925	785925	785925	791438	796950	807188	819000	822938	826875	830813	834750	838688	9726413
Interest (Building)	18860	18802	18743	18683	18623	18562	18501	18439	18377	18313	18250	18185	186338
Interest (Equip)	20886	20693	20498	20301	20101	19900	19696	19490	19282	19072	18859	18644	237422
Interest (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest (LC)	18719	18719	18774	18884	16041	16262	16419	16498	16577	16656	16734	16813	195096
Misc.	33683	33919	34155	34594	35100	35269	35438	35606	35775	35944	36113	36281	421875
TOTAL DISBURSEMENTS	1727792	1732739	1737742	1752552	1768822	1782815	1798318	1805868	1813418	1820969	1828518	1836068	21405621
Cash on Hand	3913805	4066518	4219796	4385948	4556741	4729387	4920047	5104654	5291162	5479569	5669875	5862082	25431635
Disbursements	1727792	1732739	1737742	1752552	1768822	1782815	1798318	1805868	1813418	1820969	1828518	1836068	21405621
Ending Balance	2186013	2333779	2482054	2633396	2787919	2946572	3121729	3298787	3477744	3658600	3841357	4026014	4026014
Sales	1122750	1130625	1138500	1153125	1170000	1175625	1181250	1186875	1192500	1198125	1203750	1209375	14062500
# of Sheets	49900	50250	50600	51250	52000	52250	52500	52750	53000	53250	53500	53750	625000
SOURCE OF FUNDS													
Federal Grants	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	785925	791438	796950	807188	819000	822938	826875	830813	834750	838688	842625	846563	9843750
Accounts Rec. Proceeds	1089068	1089068	1089068	1096706	1104345	1118531	1146600	1152113	1157625	1163138	1168650	1174163	13549073
Total	1874993	1880505	1886018	1903894	1923345	1941469	1973475	1982925	1992375	2001825	2011275	2020725	23392823

TABLE 15

PROJECTED OPENING BALANCE SHEET
AFTER CONSTRUCTION
For A Proposed Bison Plant

ASSETS		
Current Assets		
Cash	$ 699,125	
Accounts Receivable Grant	2,363,375	
Total Current Assets		$ 3,062,500
Depreciable Assets		
Machinery & Equipment	11,095,000	
Building	2,160,000	
Total Depreciable Assets		13,255,000
Other Assets		
Land	250,000	
Total Other Assets		250,000
TOTAL ASSETS		$ 16,567,500
LIABILITIES		
Current Liabilities		
Accrued Interest	$ 141,803	
Short Term Note Payable	2,363,375	
Total Current Liabilities		$ 2,505,178
Long Term Liabilities		
Mortgage on Building	1,807,500	
Mortgage on Equipment	6,657,000	
Total Long Term Liabilities		8,464,500
TOTAL LIABILITIES		10,969,678
CAPITAL		
Common Stock-NPV	$ 3,376,250	
Retained Earnings	2,221,572	
Total Capital		5,597,822
TOTAL LIABILITIES & CAPITAL		$ 16,567,500

TABLE 16

FIVE YEAR PROJECTED BALANCE SHEETS
Based on twelve month periods

For A Proposed Biogas Plant

ASSETS	Yr1	Yr2	Yr3	Yr4	Yr5
Current Assets					
Chequing Account	$ 1,520,649	$ 632,667	$ 4,263	$ 1,149	$ 4,747
Accounts Receivable	1,957,500	2,652,885	3,375,349	3,924,539	4,437,966
Inventory - Finished Goods	293,000	301,790	322,916	336,832	369,415
- Work in Progress	20,828	21,453	22,955	23,873	26,260
- Raw Materials	4,955	5,104	5,461	5,679	6,247
Total Current Assets	3,796,932	3,613,919	3,730,943	4,291,072	4,844,635
Depreciable Assets					
Machinery & Equipment	11,095,000	11,095,000	11,095,000	11,095,000	11,095,000
Building	2,160,000	2,160,000	2,160,000	2,160,000	2,160,000
Land	250,000	250,000	250,000	250,000	250,000
Less Depreciation	-2,327,000	-4,204,800	-6,722,270	-6,951,026	-7,947,921
Total Depreicable Assets	11,178,000	9,300,200	7,782,730	6,553,974	5,557,079
TOTAL ASSETS	$ 14,974,932	$ 12,914,119	$ 11,513,673	$ 10,845,046	$ 10,401,714
LIABILITIES					
Current Liabilities					
Accounts Payable	$ 318,784	$ 328,350	$ 351,334	$ 365,387	$ 401,925
Short Term Note Payable	2,363,375	2,363,375	2,093,375	1,816,375	726,375
Line of Credit	1,370,250	1,398,600	1,512,000	1,571,850	1,689,187
Total Current Liabilities	4,052,409	4,090,325	3,956,709	3,753,612	2,817,487
Long Term Liabilities					
Mortgage on Building	1,761,612	1,709,907	1,651,645	1,586,993	1,512,015
Mortgage on Equipment	6,309,430	5,913,887	5,463,741	4,951,463	4,368,473
Total Long Term Liabilities	8,071,042	7,623,794	7,115,386	6,537,456	5,880,488
TOTAL LIABILITIES	12,123,451	11,714,119	11,072,095	10,291,068	8,697,975
Capital					
Common Stock - NPV	3,376,511	3,376,511	3,376,511	3,376,511	3,376,511
Retained Earning	-523,769	-2,176,250	-2,934,672	-2,822,272	-1,672,511
Total Capital	2,851,481	1,200,000	441,578	553,978	1,703,739
TOTAL LIABILITIES & EQUITY	$ 14,974,932	$ 12,914,119	$ 11,513,673	$ 10,845,046	$ 10,401,714

TABLE 17

FIVE YEAR PROJECTED INCOME & EXPENSE STATEMENTS
Based on twelve month periods

For A Proposed Bison Plant

	Yr1	Yr2	Yr3	Yr4	Yr5
Operating Revenue					
Sales	$ 11,718,750	$ 13,281,250	$ 14,062,500	$ 14,843,750	$ 15,625,000
Less Discounts	1,171,875	1,328,125	1,406,500	1,484,375	1,562,500
Effective Gross Operating Income	10,546,875	11,953,125	12,656,250	13,359,938	14,062,500
Cost of Goods Sold	1,504,688	1,706,313	1,806,625	1,905,938	2,006,250
Gross Operating Margin	9,042,187	10,247,812	10,850,625	11,453,437	12,056,250
Marketing & Promotion	2,575,000	2,400,000	2,160,000	1,920,000	1,500,000
Utilities (Energy)	234,375	265,625	281,250	296,875	312,500
Maintenance	318,750	361,250	382,500	403,750	425,000
Direct Labour & Benefits	2,643,750	2,996,250	3,172,500	3,348,750	3,525,000
Total Direct Expenses	5,771,875	6,023,125	5,996,250	5,969,375	5,762,500
Gross Operating Profit	3,270,312	4,224,687	4,854,375	5,484,062	6,293,750
Administration & Office Salaries	1,607,813	1,822,188	1,929,375	2,036,563	2,143,750
Legal-Taxes-Insurance	318,744	361,248	382,500	403,740	425,004
Depreciation	2,327,000	1,877,800	1,517,470	1,228,756	996,895
Misc.	316,406	358,594	379,688	400,781	421,875
Interest Short & Long Term	1,446,690	1,456,338	1,403,764	1,301,822	1,156,465
Total General & Administrative Expense	6,016,653	5,876,168	5,612,797	5,371,662	5,143,989
OPERATING INCOME/DEFICIT BEFORE TAXES	-2,746,341	-1,651,481	-756,422	112,400	1,149,761

TABLE 18

BISON PLANT - Projected Cash Flow Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Beginning Balance	699125	2563420	2186648	2004956	1864116	1748785	1696137	1651382	1619654	1594520	1569384	1545057	699125
Cash receipts	2757125	472500	1094063	1289250	1389375	1539000	1577250	1622250	1644750	1644750	1652625	1652625	18335563
Cash on Hand	3456250	3035920	3280710	3294206	3253491	3287785	3273387	3273632	3264404	3239270	3222009	3197682	19034688
APPLICATION OF FUNDS													
Raw Materials	80250	96300	108338	125190	128400	134820	138030	138030	138030	138030	139635	139635	1504688
Energy	12500	15000	16875	19500	20000	21000	21500	21500	21500	21500	21750	21750	234375
Maintenance	17000	20400	22950	26520	27200	28560	29240	29240	29240	29240	29580	29580	318750
Direct Labour	141000	169200	190350	219960	225600	236880	242520	242520	242520	242520	245340	245340	2643750
Marketing & Promo.	250000	250000	225000	225000	225000	200000	200000	200000	200000	200000	200000	200000	2575000
Admin & Office Sal.	85750	102900	115763	133770	137200	144060	147490	147490	147490	147490	149205	149205	1607813
Legal/Tax/Ins.	26562	26562	26562	26562	26562	26562	26562	26562	26562	26562	26562	26562	318744
Loan Pymt (Building)	3618	3654	3691	3728	3765	3803	3841	3879	3918	3957	3997	4037	45888
Loan Pymt (Equip)	27279	27574	27873	28175	28480	28789	29100	29416	29734	30057	30382	30711	347570
Loan Pymts (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Pymts (LC)	0	0	393750	472500	531563	614250	630000	661500	677250	677250	677250	677250	6012563
Interest (Building)	18075	18039	18002	17965	17928	17890	17852	17814	17775	17736	17696	17657	214429
Interest (Equip)	72118	71822	71523	71221	70916	70608	70296	69980	69661	69340	69014	68685	845184
Interest (ST)	141803	23634	23634	23634	23634	23634	23634	23634	23634	23634	23634	23634	401777
Interest (LC)	0	3038	8663	10041	11458	12443	12915	13388	13545	13545	13545	13624	127103
Misc.	16875	20250	22781	26325	27000	28350	29025	29025	29025	29025	29363	29363	316406
TOTAL DISBURSEMENTS	892830	849273	1275754	1430091	1504706	1591649	1622005	1653978	1669884	1669886	1676953	1677032	17514038
Cash on Hand	3456250	3035920	3280710	3294206	3253491	3287785	3273387	3273632	3264404	3239270	3222009	3197682	19034688
Disbursements	892830	849273	1275754	1430091	1504706	1591649	1622005	1653978	1669884	1669886	1676953	1677032	17514038
Ending Balance	2563420	2186648	2004956	1864116	1748785	1696137	1651382	1619654	1594520	1569384	1545057	1520649	1520649
Sales	562500	675000	759375	877500	900000	945000	967500	967500	967500	967500	978750	978750	10546875
# of Sheets	25000	30000	33750	39000	40000	42000	43000	43000	43000	43000	43500	43500	468750
SOURCE OF FUNDS													
Federal Grants	2363375	0	0	0	0	0	0	0	0	0	0	0	2363375
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	393750	472500	531563	614250	630000	661500	677250	677250	677250	677250	685125	685125	7382813
Accounts Rec. Proceeds	0	0	562500	675000	759375	877500	900000	945000	967500	967500	967500	967500	8589375
Total	2757125	472500	1094063	1289250	1389375	1539000	1577250	1622250	1644750	1644750	1652625	1652625	18335563

TABLE 19

BISON PLANT - Projected Cash Flow

Month	13	14	15	16	17	18	19	20	21	22	23	24	Total
Beginning Balance	1520649	1437676	1388087	1274133	1194632	1116426	1038744	971041	903337	835635	767932	700229	1520649
Cash receipts	1609088	1613025	1622250	1629113	1634400	1636515	1646494	1646494	1646494	1646494	1646494	1648069	19624928
Cash on Hand	3129737	3050701	2977317	2903246	2829032	2752941	2685238	2617534	2549831	2482129	2414426	2348297	21145577
APPLICATION OF FUNDS													
Raw Materials	140438	141260	142043	142364	142364	142364	142364	142364	142364	142364	142364	142685	1705313
Energy	21875	22000	22125	22175	22175	22175	22175	22175	22175	22175	22175	22225	265625
Maintenance	29750	29920	30080	30158	30158	30158	30158	30158	30158	30158	30158	30226	361250
Direct Labour	246750	248160	249570	250134	250134	250134	250134	250134	250134	250134	250134	250698	2996250
Marketing & Promo.	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000	200000	2400000
Admin & Office Sal.	150063	150920	151778	152121	152121	152121	152121	152121	152121	152121	152121	152464	1822188
Legal/Tax/Ins.	30104	30104	30104	30104	30104	30104	30104	30104	30104	30104	30104	30104	361248
Loan Pymt (Building)	4077	4118	4159	4200	4242	4285	4328	4371	4415	4459	4503	4548	51705
Loan Pymt (Equip)	31044	31380	31720	32064	32411	32762	33117	33476	33838	34205	34576	34950	395543
Loan Pymts (ST)	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Pymts (LC)	688125	685125	689063	693000	696938	698513	698513	698513	698513	698513	698513	698513	8338838
Interest (Building)	17816	17575	17534	17493	17451	17408	17365	17322	17278	17234	17190	17145	208611
Interest (Equip)	68352	68016	67676	67332	66985	66634	66279	65920	65557	65191	64820	64446	797208
Interest (ST)	23634	23634	23634	23634	23634	23634	23634	23634	23634	23634	23634	23634	283608
Interest (LC)	13703	13742	13821	13899	13955	13970	13970	13970	13970	13970	13970	13970	166911
Misc.	29531	29700	29869	29936	29936	29936	29936	29936	29936	29936	29936	30004	358594
TOTAL DISBURSEMENTS	1692061	1685634	1703184	1708614	1712606	1714197	1714197	1714197	1714196	1714197	1714197	1715611	20512890
Cash on Hand	3129737	3050701	2977317	2903246	2829032	2752941	2685238	2617534	2549831	2482129	2414426	2348297	21145577
Disbursements	1692061	1685634	1703184	1708614	1712606	1714197	1714197	1714197	1714196	1714197	1714197	1715611	20512890
Ending Balance	1437676	1388087	1274133	1194632	1116426	1038744	971041	903337	835635	767932	700229	632687	632687
Sales	984375	990000	995625	997875	997875	997875	997875	997875	997875	997875	997875	1000125	11953125
# of Sheets	43750	44000	44250	44350	44350	44350	44350	44350	44350	44350	44350	44450	531250
SOURCE OF FUNDS													
Federal Grants	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	689063	693000	696938	698513	698513	698513	698513	698513	698513	698513	700088	8367188	
Accounts Rec. Proceeds	920025	920025	925313	930600	935888	938003	947981	947981	947981	947981	947981	947981	11257740
Total	1609088	1613025	1622250	1629113	1634400	1636515	1646494	1646494	1646494	1646494	1646494	1648069	19624928

TABLE 20

BISON PLANT - Projected Cash Flow Month	25	26	27	28	29	30	31	32	33	34	35	36	Total
Beginning Balance	632687	583358	535061	487928	443528	404322	369502	349721	331810	315596	301059	287661	632687
Cash receipts	1648069	1654931	1666744	1684969	1712813	1732781	1763325	1773450	1782000	1788480	1792800	1792800	20793161
Cash on Hand	2280756	2238290	2201805	2172897	2156341	2137103	2132827	2123171	2113810	2104076	2093859	2080461	21425848
APPLICATION OF FUNDS													
Raw Materials	142685	143648	146055	148463	150870	151673	152475	153438	154080	154080	154080	154080	1805625
Energy	22225	22375	22750	23125	23500	23625	23750	23900	24000	24000	24000	24000	281250
Maintenance	30226	30430	30940	31450	31960	32130	32300	32504	32640	32640	32640	32640	382500
Direct Labour	250698	252390	256620	260850	265080	266490	267900	269592	270720	270720	270720	270720	3172500
Marketing & Promo.	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	180000	2160000
Admin & Office Sal.	152464	153493	156065	158638	161210	162068	162925	163954	164640	164640	164640	164640	1929375
Legal/Tax/Ins.	31875	31875	31875	31875	31875	31875	31875	31875	31875	31875	31875	31875	382500
Loan Pymt (Building)	4594	4640	4686	4733	4780	4828	4877	4925	4975	5024	5075	5125	58262
Loan Pymt (Equip)	35329	35712	36099	36490	36885	37285	37689	38097	38510	38927	39348	39775	450146
Loan Pymts (ST)	0	0	0	0	0	0	0	0	0	0	0	270000	270000
Loan Pymts (LC)	698513	700088	700088	704813	716625	728438	740250	744188	748125	752850	756000	756000	8745975
Interest (Building)	17099	17053	17007	16960	16913	16865	16816	16768	16718	16669	16618	16568	202054
Interest (Equip)	64067	63684	63297	62906	62511	62111	61708	61299	60887	60469	60048	59621	742608
Interest (ST)	23634	23634	23634	23634	23634	23634	23634	23634	23634	23634	23634	23634	283608
Interest (LC)	13986	14002	14049	14214	14481	14687	14844	14923	15010	15089	15120	15120	175494
Misc.	30004	30206	30713	31219	31725	31894	32063	32265	32400	32400	32400	32400	379688
TOTAL DISBURSEMENTS	1697397	1703229	1713877	1729369	1752019	1767601	1783106	1791362	1798214	1803017	1806198	2076198	21421585
Cash on Hand	2280756	2238290	2201805	2172897	2156341	2137103	2132827	2123171	2113810	2104076	2093859	2080461	21425848
Disbursements	1697397	1703229	1713877	1729369	1752019	1767601	1783106	1791362	1798214	1803017	1806198	2076198	21421585
Ending Balance	583358	535061	487928	443528	404322	369502	349721	331810	315596	301059	287661	4263	4263
Sales	1000125	1006875	1023750	1040625	1057500	1063125	1068750	1075500	1080000	1080000	1080000	1080000	12656250
# of Sheets	44450	44750	45500	46250	47000	47250	47500	47800	48000	48000	48000	48000	562500
SOURCE OF FUNDS													
Federal Grants	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	700088	704813	716625	728438	740250	744188	748125	752850	756000	756000	756000	756000	8859375
Accounts Rec. Proceeds	947981	950119	950119	956531	972563	988594	1015200	1020600	1026000	1032480	1036800	1036800	11933786
Total	1648069	1654931	1666744	1684969	1712813	1732781	1763325	1773450	1782000	1788480	1792800	1792800	20793161

TABLE 21

BISON PLANT - Projected Cash Flow

Month	37	38	39	40	41	42	43	44	45	46	47	48	Total
Beginning Balance	4263	11794	5134	14352	2144	3197	2546	4088	2114	490	4296	2395	4263
Cash receipts	1792800	1800675	1808550	1827225	1840388	1854338	1868749	1873114	1873114	1873901	1873901	1874993	22161746
Cash on Hand	1797063	1812469	1813684	1841577	1842532	1857535	1871295	1877202	1875228	1874391	1878197	1877387	22166010
APPLICATION OF FUNDS													
Raw Materials	154080	155685	157290	158895	159377	160019	160019	160019	160019	160179	160179	160179	1905938
Energy	24000	24250	24500	24750	24825	24925	24925	24925	24925	24950	24950	24950	296875
Maintenance	32640	32980	33320	33660	33762	33898	33898	33898	33898	33932	33932	33932	403750
Direct Labour	270720	273540	276360	279180	280026	281154	281154	281154	281154	281436	281436	281436	3348750
Marketing & Promo.	160000	160000	160000	160000	160000	160000	160000	160000	160000	160000	160000	160000	1920000
Admin & Office Sal.	164640	166355	168070	169785	170300	170986	170986	170986	170986	171157	171157	171157	2036563
Legal/Tax/Ins.	33645	33645	33645	33645	33645	33645	33645	33645	33645	33645	33645	33645	403740
Loan Pymt (Building)	5177	5228	5281	5333	5387	5441	5495	5550	5605	5662	5718	5775	65652
Loan Pymt (Equip)	40206	40641	41081	41527	41976	42431	42891	43355	43825	44300	44780	45265	512278
Loan Pymts (ST)	0	15000	0	25000	15000	20000	30000	35000	35000	30000	36000	36000	277000
Loan Pymts (LC)	756000	756000	756000	763875	771750	779625	781988	785138	785138	785138	785138	785925	9291713
Interest (Building)	16516	16465	16412	16360	16306	16252	16198	16143	16088	16031	15975	15918	194664
Interest (Equip)	59191	58755	58315	57870	57420	56965	56505	56041	55571	55096	54616	54131	680476
Interest (ST)	20934	20934	20784	20784	20634	20384	20184	19884	19534	19184	18884	18524	240548
Interest (LC)	15120	15120	15199	15356	15514	15616	15671	15703	15703	15703	15711	15719	186134
Misc.	32400	32738	33075	33413	33514	33649	33649	33649	33649	33683	33683	33683	400781
TOTAL DISBURSEMENTS	1785269	1807336	1799332	1839433	1839335	1854989	1867207	1875088	1874738	1870095	1875803	1876238	22164860
Cash on Hand	1797063	1812469	1813684	1841577	1842532	1857535	1871295	1877202	1875228	1874391	1878197	1877387	22166010
Disbursements	1785269	1807336	1799332	1839433	1839335	1854989	1867207	1875088	1874738	1870095	1875803	1876238	22164860
Ending Balance	11794	5134	14352	2144	3197	2546	4088	2114	490	4296	2395	1149	1149
Sales	1080000	1091250	1102500	1113750	1117125	1121625	1121625	1121625	1121625	1122750	1122750	1122750	13359375
# of Sheets	48000	48500	49000	49500	49650	49850	49850	49850	49850	49900	49900	49900	593750
SOURCE OF FUNDS													
Federal Grants	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	756000	763875	771750	779625	781988	785138	785138	785138	785138	785925	785925	785925	9351563
Accounts Rec. Proceeds	1036800	1036800	1036800	1047600	1058400	1069200	1083611	1087976	1087976	1087976	1087976	1089068	12810184
Total	1792800	1800675	1808550	1827225	1840388	1854338	1868749	1873114	1873114	1873901	1873901	1874993	22161746

TABLE 22

BISON PLANT - Projected Cash Flow Month	49	50	51	52	53	54	55	56	57	58	59	60	Total
Beginning Balance	1149	4492	4050	4817	4350	2813	1208	1956	605	2203	1751	14299	1149
Cash receipts	1874993	1880505	1886018	1903894	1923345	1941469	1973475	1982925	1992375	2001825	2011275	2020725	23392823
Cash on Hand	1876142	1884997	1890067	1908711	1927695	1944281	1974683	1984881	1992980	2004028	2013026	2035024	23393972
APPLICATION OF FUNDS													
Raw Materials	160179	161303	162426	164513	166920	167723	168625	169328	170130	170933	171735	172538	2006250
Energy	24950	25125	25300	25625	26000	26125	26250	26375	26500	26625	26750	26875	312500
Maintenance	33932	34170	34408	34850	35360	35530	35700	35870	36040	36210	36380	36550	425000
Direct Labour	281436	283410	285384	289050	293280	294690	296100	297510	298920	300330	301740	303150	3525000
Marketing & Promo.	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000	125000	1500000
Admin & Office Sal.	171157	172358	173558	175788	178360	179218	180075	180933	181790	182648	183505	184363	2143750
Legal/Tax/Ins.	35417	35417	35417	35417	35417	35417	35417	35417	35417	35417	35417	35417	425004
Loan Pymt (Building)	5833	5891	5950	6010	6070	6131	6192	6254	6316	6380	6443	6508	73978
Loan Pymt (Equip)	45755	46251	46752	47259	47771	48288	48811	49340	49874	50415	50961	51513	582990
Loan Pymts (ST)	65000	70000	70000	75000	80000	85000	100000	105000	105000	110000	100000	125000	1090000
Loan Pymts (LC)	785925	785925	785925	791438	796950	807188	819000	822938	826875	830813	834750	838688	9726413
Interest (Building)	15860	15802	15743	15683	15623	15562	15501	15439	15377	15313	15250	15185	186338
Interest (Equip)	53641	53145	52644	52138	51626	51108	50585	50056	49522	48981	48435	47883	609764
Interest (ST)	18164	17514	16814	16114	15364	14564	13714	12714	11664	10614	9514	8514	165268
Interest (LC)	15719	15719	15774	15884	16041	16262	16419	16498	16577	16656	16734	16813	195095
Misc.	33683	33919	34155	34594	35100	35269	35438	35606	35775	35944	36113	36281	421875
TOTAL DISBURSEMENTS	1871650	1880947	1885250	1904361	1924882	1943073	1972727	1984277	1990777	2002277	1998727	2030277	23389225
Cash on Hand	1876142	1884997	1890067	1908711	1927695	1944281	1974683	1984881	1992980	2004028	2013026	2035024	23393972
Disbursements	1871650	1880947	1885250	1904361	1924882	1943073	1972727	1984277	1990777	2002277	1998727	2030277	23389225
Ending Balance	4492	4050	4817	4350	2813	1208	1956	605	2203	1751	14299	4747	4747
Sales	1122750	1130625	1138500	1153125	1170000	1175625	1181250	1186875	1192500	1198125	1203750	1209375	14062500
# of Sheets	49900	50250	50600	51250	52000	52250	52500	52750	53000	53250	53500	53750	625000
SOURCE OF FUNDS													
Federal Grants	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Term Loan Proceed	0	0	0	0	0	0	0	0	0	0	0	0	0
Line of Credit Proceeds	785925	791438	796950	807188	819000	822938	826875	830813	834750	838688	842625	846563	9843750
Accounts Rec. Proceeds	1089068	1089068	1089068	1096706	1104345	1118531	1146600	1152113	1157625	1163138	1168650	1174163	13549073
Total	1874993	1880505	1886018	1903894	1923345	1941469	1973475	1982925	1992375	2001825	2011275	2020725	23392823

4.3. Conclusions

4.3.1 Fulgurit

The Cochrane location is determined in this study to be the more profitable due to the cheaper delivered cost of the cement. Even though the land cost is higher by $ 2,000 an acre the savings on raw material amount to approximately $ 500,000 accumulated over five years. Profit is recognized in the second year of operation and with a capital investment of 25% i.e. less than two million dollars the investors can realize a return on investment of 107 % accumulative over five years.

4.3.2 Bison

The Cochrane location is again determined to be the better location for this facility. The prohibitive factor in this case is that the capital expenditure requires major support through loans. In result this plant does not realize a profit until the fourth year and the return on investment is only 9% accumulative over five years. Our projections are based on a minimum investment of $ 3.4 million with major lending support. We estimate that the capital investment would have to be doubled to realize a substantial return on investment within the first five years.

APPENDIX A

Machinery Specification and Machinery List

f o r

1 BISON - CEMENT - BOARD - PLANT

Size: 1,250 x 2,600 - 3,200 mm

Capacity : 75 m³/21 h

Technical Data - Total Plant

Basic Data of Plant

Net size:	1,250 x 2,600 - 3,200 mm
Gross size:	1,300 x 2,650 - 3,250 mm
Guaranteed capacity:	75 m³/21 h = 18,750 m³/a
at a thickness:	8 mm
and a spec. weight of:	approx. 1,250 kg/m³ - finished board
Board thicknesses:	8 - 40 mm
Wood:	Debarked pinewood comparable to pine, spruce, fir according to specifications, asp, birch
Cement:	type PZ 45 F
Chemicals and water:	according to specifications
Heating:	steam, 7 bar
Current:	440 V, 60 Hz.
Control voltage:	110 V, 60 Hz US-Standards

The given data for wood, cement or chemicals are not restricted to the above-mentioned species.
In prinicple other wood species, cements or chemicals can be utilized.
Prior to final layout, the suitability of the materials must be tested in our laboratory.

Plant Design Features

Plant capacity:	75 m³/21 h with basic size
Net size:	max. 1,250 x 3,200 mm; 4.00 m² min. 1,250 x 2,600 mm
Gross size:	max. 1,300 x 3,250 mm min. 1,300 x 2,650 mm
Board thicknesses:	8 - 40 mm
Basic size:	1,250 x 3,200 x 8 mm
Boards per hours **Board thicknesses:**	8 mm = 89 pcs. = 60 m³/21 h 10 mm = 89 pcs. = 75 m³/21 h 12 mm = 74 pcs. = 75 m³/21 h 14 mm = 64 pcs. = 75 m³/21 h 16 mm = 56 pcs. = 75 m³/21 h

PLANT DESIGN

The machines are equipped as specified in the machinery list. For deviations of the electrical data outlined in the technical specifications, we have to charge the extra price in addition. Adapted to the motors, the plant is provided with the required switching units installed in the respective switchboards. The machines are designed according to VDE-standards in the electrical field and as per German TÜV-conditions in the mechanical field. In case of deviations, the extra price has to be additionally charged.

Unless otherwise stated, the following equipment is excluded from our supply volume:
Cable connections between the terminals of the switchboards and the connections of motors and limit switches as well as the supply line to the switchboards, the oil fillings of gearings and the lubricants, all supporting structures, operation platforms, railings, ladders, stairs and transfer chutes for machines as well as for mechanic and pneumatic transports, unless specifically mentioned in the machine list.

The machines are delivered according to the latest state of engineering and are equipped with tools and wear parts required for the first operation.

The machines are provided with a prime and finish coat. Lacquering required after assembly has to be provided by the customer.

We reserve the right of constructional modifications for the purpose of simplification and improvement, respectively.

Technical Plant Description

For the production of cement-bonded boards the plant can be split up in the following sections:

1. Storage of raw material
   (wood yard, cement silos, chemical store)
2. Flaking
3. Storing
4. Milling
5. Fractionating in fine and coarse material
6. Storing
7. Mixing of wood, cement and chemicals
8. Forming
9. Pressing
10. Hardening
11. Destacking
12. Maturing
13. Drying
14. Trimming

1. Wood Yard

Debarked wood should be stored for about 2 - 3 months in such a way that rotting and mildewing will not appear. The storage will help to equalize the wood moisture content and to decrease the concentration of components which are not compatible for the setting of cement.

2. Flaking

The debarked round wood is conveyed to the drum flaker by means of a feeding trough.

3. Storing

The flakes produced by the flaker are intermediately stored in a bin. A special discharge device guarantees a continuous and exact metering of the flakes into the hammermill.

4. Milling

The flakes coming from the hammermill are delivered to a screen. Coarse material from the screen is conveyed to the refining mill for processing.

5. Fractionating

Flakes are separated into coarse and fine material by means of a screening machine. The oversized material is conveyed back to the refining mill for further disintegration.

6. Storing

Material selected as normal is stored intermediately and fed cyclewise to the flake scale. In a separate section of this bin, the waste material coming from the trimming saw is stored and discharged to the scale in metered quantity.

7. Mixing

Mixing is done in a special mixer, where the various components are fed on programme. The components are weighed; the basis of the quantity of cement is the dry weight of the wood flakes. The quantity of chemicals, which are used as binding accelerator is based on the quantity of cement.

The composition of the mixture is such that in the finished board there will be

about 61 % cement
about 23 % wood
about 16 % water,
chemically and physically bonded

It is possible to reduce the amount of cement and increase the reciprocal amount of organic elements respectively. Although, the technological characteristics of the product will change.

8. Forming

The efficiency of the forming determines the surface quality and the thickness tolerances of the finised board. It is necessary to keep the forming exactitude in narrow limits. The forming heads are to be regulated according to the comparatively high moisture content of the mixed material. BISON can also use the air-classification system for this material.
Since the material is sifted according to flake sizes, it is possible to obtain by air-classification forming a very good surface quality. The plants are operating with 4 forming heads. The material is spread continously on transport cauls. The weight is controlled in order to reject misspreads. Misspread material is fed back to the forming station.
The endless spread mat on the cauls is sectioned after the spreading on an extractor conveyor and is transported to the loading device.

9. Pressing

After forming the board mats, the mats are put together to packages in a stacking plant. The packages are formed in special clamping frames. In the press the packages are pressed together up to a thickness called clamp size (spec. pressure up to 30 kp/cm²). The clamp size is to be the board thickness plus caul thickness and the number of boards per package. The setting process requires a certain period, so that the board packages have to remain absolutely unchanged in the clamping frame during this time. The clamping frames are for that reason constructed in an accurate and stable way. The press is also used to open the clamp device after the curing process.

10. Hardening

In order to execute the setting process under controllable conditions, the packages fixed in the clamping frames are prehardened under heat in a hardening channel in such a way that after approx. 6 - 8 hours the boards can be destacked.

11. Destacking

The destacking is done alternately - cement board - caul - cement board - caul. The boards are destacked on pallets and are transported to the maturing place. The transport cauls are cleaned, provided with a parting compound and returned to the forming section. The balance of the caul number - when changing the board thicknesses - is done by adding or removing cauls in or out of the caul store.

12. Maturing

Maturing occurs (for about 7 days) after destacking and separating of boards from the transport supports. After this period the pallets have obtained 80 % of the final strength.

13. Drying

The moisture content of the boards, before leaving the factory, can be adapted in order to equalize the moisture between board and atmosphere (recommended for a good form stability).
Drying occurs in a circulating channel. Each board is transported through this channel individually, in upright position, held by a special stake transport system.

14. Trimming

After drying, the boards are taken out of the stake transport system onto the trimming saw where they are trimmed in net sizes. Packages are formed in the following destacking plant and are transported with floor conveying devices to the finish board store, to the sanding line or in the board separation plant.

Technical Specification

Raw material specification

Wood

Debarked pine wood, comparable to fir, spruce, pine.
The wood must be compatible with cement and must not be rotten.

Moisture content u = 70 % - assumed -
Wood length before flaking max. 6,500 mm
Wood diameter 100 - 500 mm

Special care should be taken for wood. This starts with the felling of wood. In principle, only sound wood should be used, felled in autumn or winter. At this period, the concentration of detrimental material in the wood is low. If wood is to be used for any reason that does not originate from the above-mentioned periods, the wood should be subject to tests after 2 - 3 months storage with regard to compatibility with cement. The wood must be completely debarked. Only 2 % of bark can be accepted. Wood that is rotten or attacked by fungus should be separated.

Other wood species can be used.

In our research center about 130 wood species were found out to be compatible.
For each plant, the available wood species are examined and tested in order to formulate the ideal relation of the different components.

Cement

Two characteristics are important:

1. The strength achieved after 2 days, the so-called advanced strength, has to have a compressive stength of 25 x 10^6 N/m².
2. The final strength after 28 days has to have 45 x 10^6 N/m².

The type and quality of cement should by all means be constant for each delivery. It is recommended to take samples from each delivery and to collect them for a certain period.

Cement should be stored in silos which are protected against moisture in order to retain the setting ability. Cement which is stored in the open air takes up the air humidity and also carbonic acid gas which results in lump formation and a reduction in the setting ability which on the other hand negatively affects the process and the adavanced setting.

The storage time should not exceed 1 month. When stored for a longer period, losses in strength figures have to be considered to about 10 %.

When using cement of inferior quality, the strength of the cement board may deteriorate.

Aluminium sulfate $(Al_2 (SO_4) 18 H_2O$

Specification

Al_2O_3	17 % corresp. 57 % $Al_2(SO_4)_3$
Fe	max. 0.8×10^{-3} %
Na_2O	0.1 - 0.2 %
H_2SO_4 resp.	max. 0.1 %
insoluble parts	max. 0.2 %
water of crystallization	43 %

Aluminium sulfate is used to accelerate the cement setting.

The product is delivered as a granulate (up to 5 mm size) or as a fine powder. Paper bags are mainly used as packing. It should be stored in dry rooms.

Aluminium sulfate is water-soluble. A low concentration solution is normally prepared. Depending upon the product type (powder or granulate), the dissolving period is up to 1 hour.

When purchasing aluminium sulfate, one should observe the uniform concentration within the product.

Depending upon the used wood or cement, also another catalyst may be used.

Sodium silicate ($Na_2(SiO_3)$)

Specification

Na_2O	8.2 - 8.6 %
SiO_2	25.7 - 27.0 %
Molar ratio	3.25 - 3.35 %
Viscosity/25°	60 - 120 cps
Density (40 %)	1.3 kg/m³
Aspect	liquid - colourless
Fe_2O_3	max. -0.1 %
pH-value	11 - 12

Sodium silicate is used for increasing the advanced strength and acts also as setting catalyst.

It is supplied as liquid in barrels or tanks. One should keep the barrels or tanks closed, since liquid sodium silicate with the said concentration will crystallize with contact to the air.

Depending upon wood and cement used, another catalyst may also be used.

Water (H_2O)

a) Process water

Specification

pH-value:	6 - 7
Water temperature:	8 - 20°C free of organic contamination with nearly drinking water quality

The water is added to the mixture in a quantity relative to the flake moisture content in order to obtain a constant moisture content of the mixed material.

b) Preparation water for parting compound

Specification

pH-value:	6 - 7
Water temperature:	8 - 20°C free of organic contamination with nearly drinking water quality
Water hardness:	max. 12° dH

The water is required for preparing the parting compound. The parting compound is applied on the caul surfaces and on the clamps and thus avoids sticking of the boards.

Special oil (parting compound)

A parting compound is produced out of a special oil and water (max. 12° dH) which is used to avoid cement board stickings to the cauls and at the upper side of the cover on the clamping frames.

Following types can be used:

- Mobil 6801, Messrs. Mobil Oil
- Karizol 223, Messrs. Kuhbier Chemie
- Granitol W, Messrs. Aral
- Texaform R, Messrs. Texaco
- Formenoel E-4, Messrs. Esso

or equivalent types.

APPENDIX B

Fulgurit Systems Inc.
Pyrock Division
1023 48th. Street
Newport News, VA. 23607

Re: Testing of Fulgurit
Floor and/or Wall Panels

Job # 19996-1
March 10, 1982

Objective

To test Fulgurit Panels as non-combustible protective panels by subjecting them to the heat produced by a solid burning room heater which has been tested and approved to UL 1482, the Standard for Solid Fuel Type Room Heaters.

Specimens

The floor and wall panels are identical, each approximately 4 feet square and 11/16" (18mm) thick.

Mounting

In a test structure as described in section 8 of UL 1482, an 11/16 inch thick panel was mounted on 1 inch non-combustible spacers, 1 inch above the floor, in front of the combustible wall. A similar panel was positioned directly on the combustibel floor. Thermocouples were positioned to register temperatures on both combustible surfaces. A stove previously tested and approved to UL 1482 was positioned at 12 inches from the wall panel.

Test Procedure

A Brand and a Flash Fire Test was conducted per UL 1482. The figures listed below represent the highest temperature reached within test areas where numerous temperature readings were taken.

The non-combustible Fulgurit Panels were subjected to flame and passed the one hour minimum fire rating (no combustion occurred).

Results

Brand Test - With Fulgurit Panels

	Temperature (°F)	Ambient	Temperature Rise	Maximum Allowed
Stove at 12" from protected combustible wall	166	83	82	90
Floor	170	83	87	90
Same Stove without panels				
Side wall at 36"	183	79	104	117
Floor	171	83	88	90

Flash Test - With Fulgurit Panels

	Temperature (°F)	Ambient	Temperature Rise	Maximum Allowed
Stove at 12" from wall panel	161	81	80	140
Floor	166	81	85	140
Same Stove without panels				
Side wall at 36"	163	82	81	140
Floor	162	82	80	140

Conclusion

11/16" Fulgurit Panels effectively protect combustibles from the heat of an approved radiant solid fuel room heater located at 12 inches from the panel when mounted 1" from the protected surface and a 1" fixed air space below. As floor protection, they are equivalent to 3/8 inch asbestos millboard, which is approved with the stove. Therefore, approved stoves labeled clearances to combustibles can be reduced by 67%.

Fulgurit Panels	Fire Test	Stove Surface	Floor Below Stove	Wall Behind Stove	Wall Beside Stove
Brand Fire Test 6 Hours	Max. Temp. Ambient	———	170° 83° 87°	———	165° 83° 82°
Flash Fire Test 30 minutes	Max. Temp. Ambient	———	166° 81° 85°	———	161° 81° 80°

Respectfully submitted

ARNOLD GREENE TESTING LABORATORIES, INC.

William J. Power
Manager Product Testing

mtm

(Original on File)

APPENDIX C

MARKET SURVEY QUESTIONNAIRE - RESULTS -

The information gathered through the interviews and questionnaires is confidential and kept in our files.

The Editors

FULGURIT®
Isopanel

APPENDIX D

INFORMATION

OUTSIDE CLADDING (FACADE)

INFO 6/4 - as per July 1981

Leaf 1 — 1. RANGE OF APPLICATION

2. THE SYSTEM OF THE CURTAIN WALL VENTILATION

3. EMBODIMENTS

3.1. Massive wall, wooden furring, heat insulation, external plaster (or rendering)

Leaf 2 — 3.2. Massive wall, wooden furring, counter lathing with heat insulation, coating

3.3. Light wall timber panel, construction method, wooden furring, external plaster coating

3.4. Massive wall, light metal furring, plaster coating

3.5. Massive wall, light metal furring, heat insulation, coating

3.6. Hall construction, construction of animal quarters (steel structural skeleton), wooden furring, transparent impregnation (prime coat)

Leaf 2+3 — 4. DETAILS ON CONNECTION

Leaf 4 — 4.1. Joint design, fasteners

5. SPACINGS OF SUPPORTS AND FIXATIONS

Leaf 4+5 — 6. RECOMMENDATIONS FOR APPLICATION

Leaf 5 — 7. COATINGS

8. TECHNICAL DATA

9. ADDRESSES OF COMPANIES SUPPLYING ACCESSORY MATERIALS

1. EXTERNAL WALL CLADDING WITH CEMENT-BOUND WOOD CHIP BOARDS

Manifold requirements to be met by the facade determine the choice of the suitable building material in order to avoid any risks in constructional engineering and economical losses.

As a building material for external walls predominantly in the construction of prefabricated houses, the wooden chipboard has conquered a very good market position, this field of application is, however, without risks only then when certain preconditions which are connected with expenditure, are fulfilled.

The organically bound chip board as curtain wall is subjected to increased stresses, which according to the latest stand of engineering can be met better by a cement-bound chip board.

The following properties of FULGURIT-ISOPANEL guarantee a reliable use provided the application is appropriate to the building material:

- in the case of humidity and a changing degree of humidity or high temperatures with simultaneously existing humidity, the capacity of the binding agent cement and the bonding of the ISOPANEL board is far superior to the well known chip boards bonded with synthetic resin,
- safe under change from frost to thawing according to DIN 52104,
- minimum swelling in thickness,
- above average sorption behaviour up to 90 % relative humidity of the air,
- good bending and rupture strength under impace loading,
- positive heat insulation,
- continuous diffusion behaviour,
- safety against wood-destroying fungi,
- outstanding values of insulation of airborne sound,
- flame resistant (not easily inflammable) building material (B 1)
- machine properties identical to wood,
- versatile coating possibility,
- favourable price in comparison to other external wall cladding materials

2. THE SYSTEM OF THE FACADE WITH VENTILATED CURTAIN WALL

FULGURIT-ISOPANEL as facade with ventilated curtain wall has proved successful in practice. In this connection the efficacy of the several mechanisms of dehumidification and their basic knowledge are of importance.

Taking large-size facing boards as a basis the removal of moisture in the wall (from weathering or otherwise penetraded inside moisture of the air) in the construction of a ventilated curtain wall is taking place mainly by means of the air flowing through the air gap. This flow is caused by the thermal buoyancy owing to temperature and thus the differences in density of the outside air and the air in the air gap, as well as owing to the difference in atmospheric (or dynamic) pressure occurring above the height of the wall, in the case of an outflow of wind.

Being aware of this function described above, a sufficient space for ventilation behind the curtain wall of 25 mm and the arrangement of slits (interstices) is indispensible for a safe construction.

3. EXAMPLES OF APPLICATION (Embodiments)

3.1. Massive wall, wooden furring, heat insulation, exterior plaster coating (or rendering)

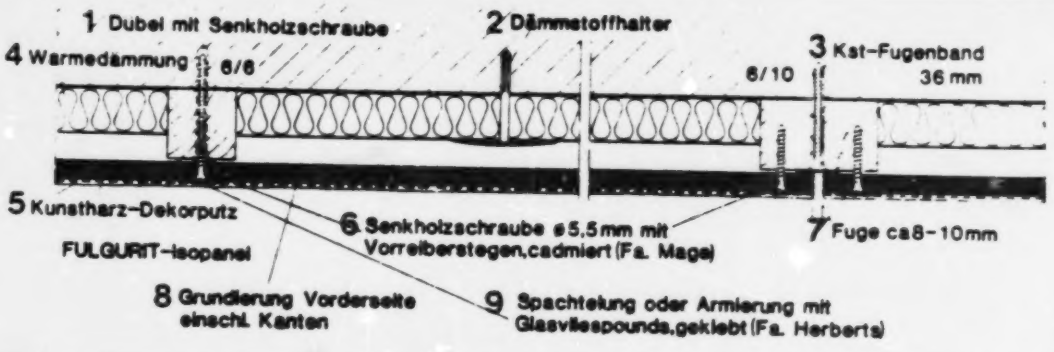


Bild 1

1 dowel with flush wood screw
2 holder for insulating material
3 plastic slit strip 36 mm
4 heat insulation
5 synthetic resin decorative plaster (or rough cast)
6 flush wood screw with casement fastener cross pieces, cadmium coated
7 split approx 8-10 mm or interstice
8 prime coating front side including edges
9 grouting or reinforcement with glassfibre mats, glued (or bonded) (from the Company HERBERTS)

3.2. Massive wall, wooden furring (= light wooden battens or metal sections fixed to solid backgrounds for subsequent attachment of lathing or sheet materials), counter-lathing with heat insulation, paint coating

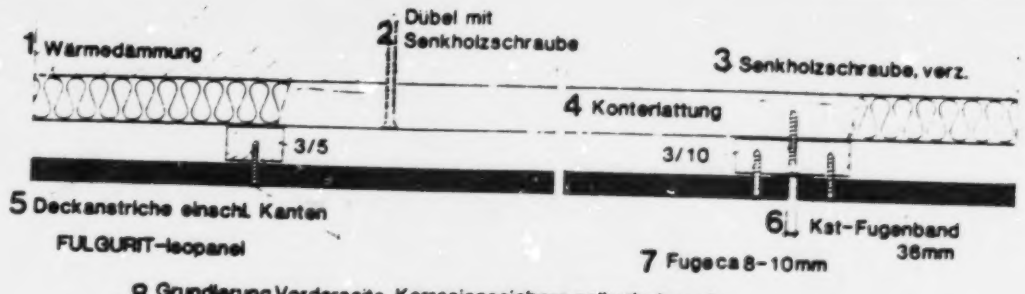


Bild 2

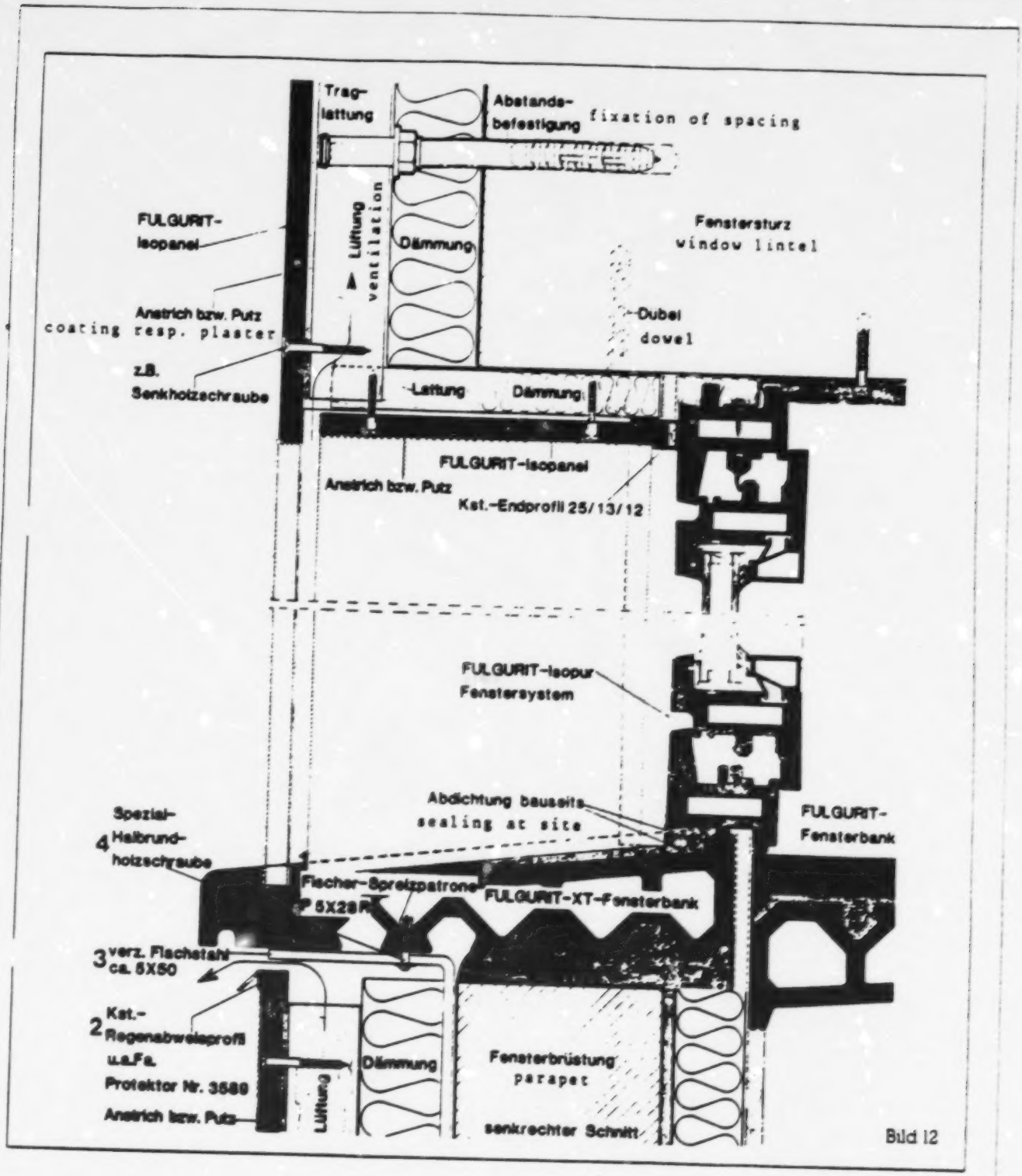
1 heat insulation
2 dowel with flush wood screw
3 flush wood screw galvanized
4 counter-lathing
5 top coat including edges
6 plastic slit strip 36mm
7 slit approx. 8-10 mm
8 prime coating front side including edges
9 corrosion-proof, self-drilling wood screws

3.3. Light weight wall - wooden board construction method - wood furring plaster coating

1 Senkholzschraube, verz.
3/5
3/10
2 Kunstharz-Dekorputz
FULGURIT-Isopanel
3 Senkholzschraube ø 5,5 mm mit Vorreiberstegen, cadmiert (Fa. Magel
4 Kst-Fugenband 36 mm
5 Fuge ca 8-10 mm
6 Grundierung Vorderseite einschl. Kanten
7 Spachtelung oder Armierung mit Glasvliespounds, geklebt (Fa. Herberts)

Bild 3

1 flush wood screw glavanized
2 synthetic resin decorative plaster (or rough cast)
3 flush wood screw with casement fastener cross pieces, cadmium coated
4 plastic slit strip
5 slit approx. 8-10 mm
6 prime coating front side including edges
7 grouting or reinforcement with glassfibre mats, glued (or bonded) (from the Company HERBERTS)



1 FISCHER (proper name) expansion shell
2 plastic rain repelling profile
3 galvanized flat steel
4 special half-round wood screw

3.4. Massive (or fireproof) wall,
light weight metal,
exterior plaster coating

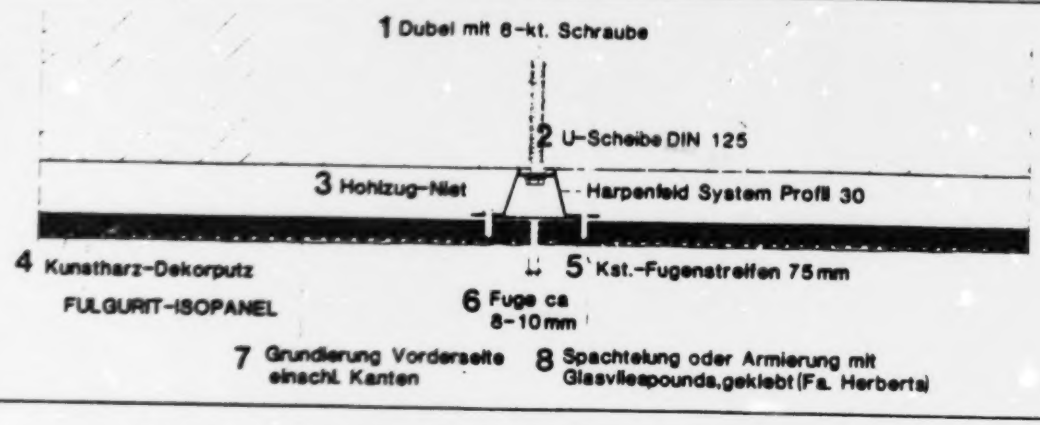

1 Dubel mit 6-kt. Schraube
2 U-Scheibe DIN 125
3 Hohlzug-Niet
Harpenfeld System Profil 30
4 Kunstharz-Dekorputz
FULGURIT-ISOPANEL
5 Kst.-Fugenstreifen 75 mm
6 Fuge ca 8-10 mm
7 Grundierung Vorderseite einschl. Kanten
8 Spachtelung oder Armierung mit Glasvliespounds, geklebt (Fa. Herberts)

Bild 4

1 dowel with hexagonal bolt (or scre)
2 washer DIN 125
3 hollow draw rivet
4 synthetic resin decorative plaster
5 plastic slit-strip 75 mm
6 slit approx. 8-10 mm
7 prime coating front side including edges
8 grouting or reinforcement with glassfibre mats, glued

3.5. Massive wall, light weight metal,
heat insulation, paint coating

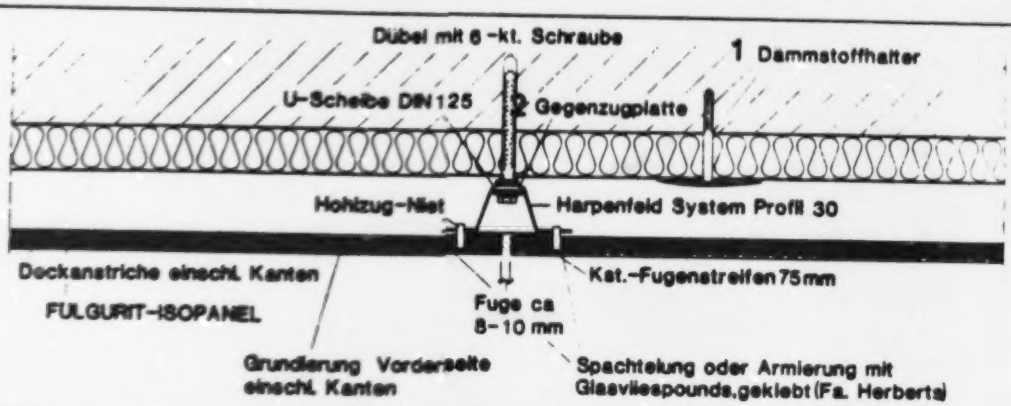


Bild 5

1 holder for insulating material
2 counter-move (or back pull) plate
etc. - see translations above

3.6. Hall construction, animal quarter,s, (steel structure skeleton), wooden furring, transparent impregnation (prime coat)

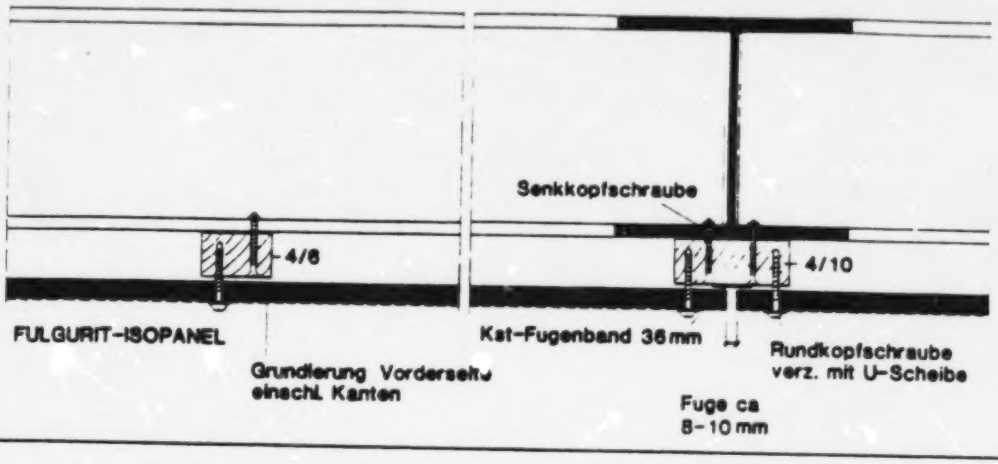


Bild 6

see translation given above

4. DETAILS ON CONNECTIONS

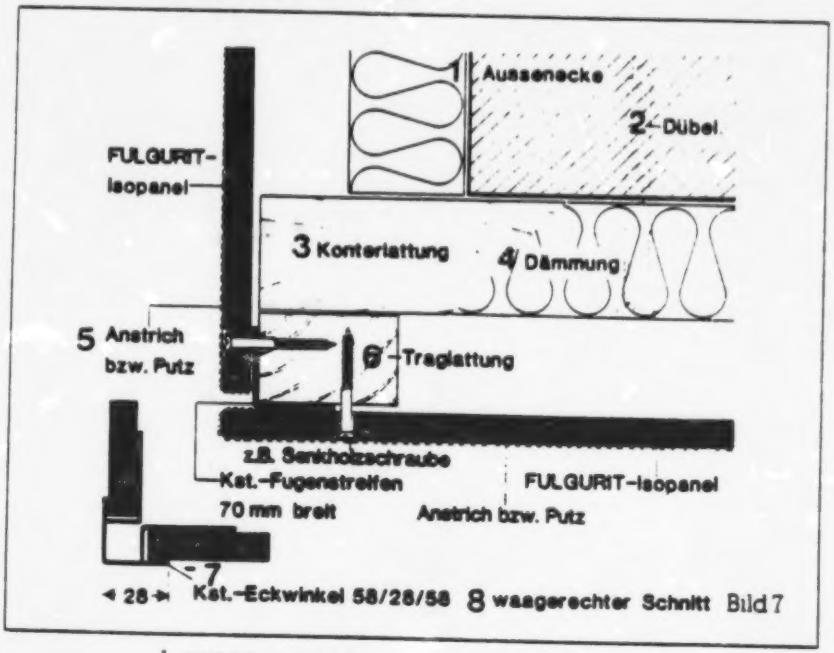


Bild 7

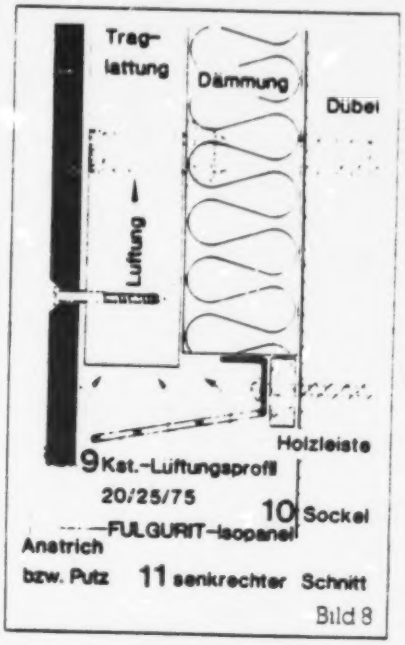


Bild 8

1 outer corner
2 dowel
3 counter lathing
4 insulation
5 paint coating or plaster
6 carrying lathing
7 corner angle
8 horizontal cross section
9 ventilation profile
10 socket
11 vertical cross section

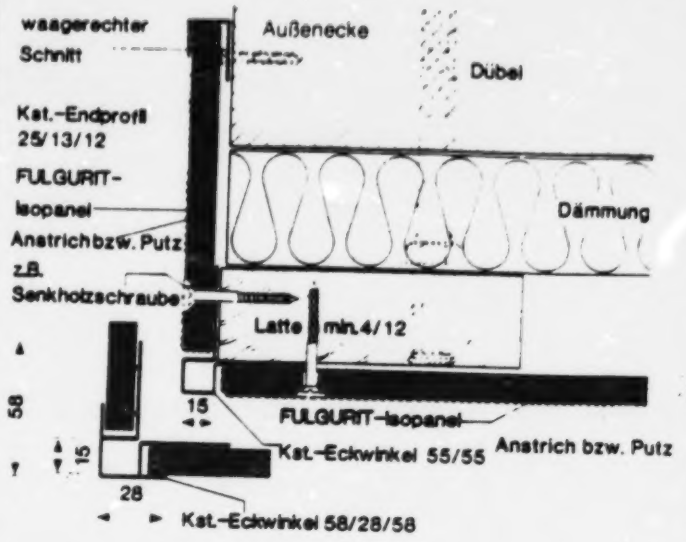


Bild 9

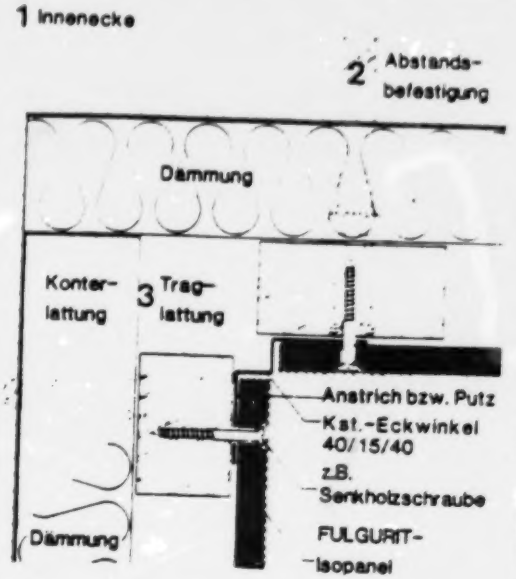
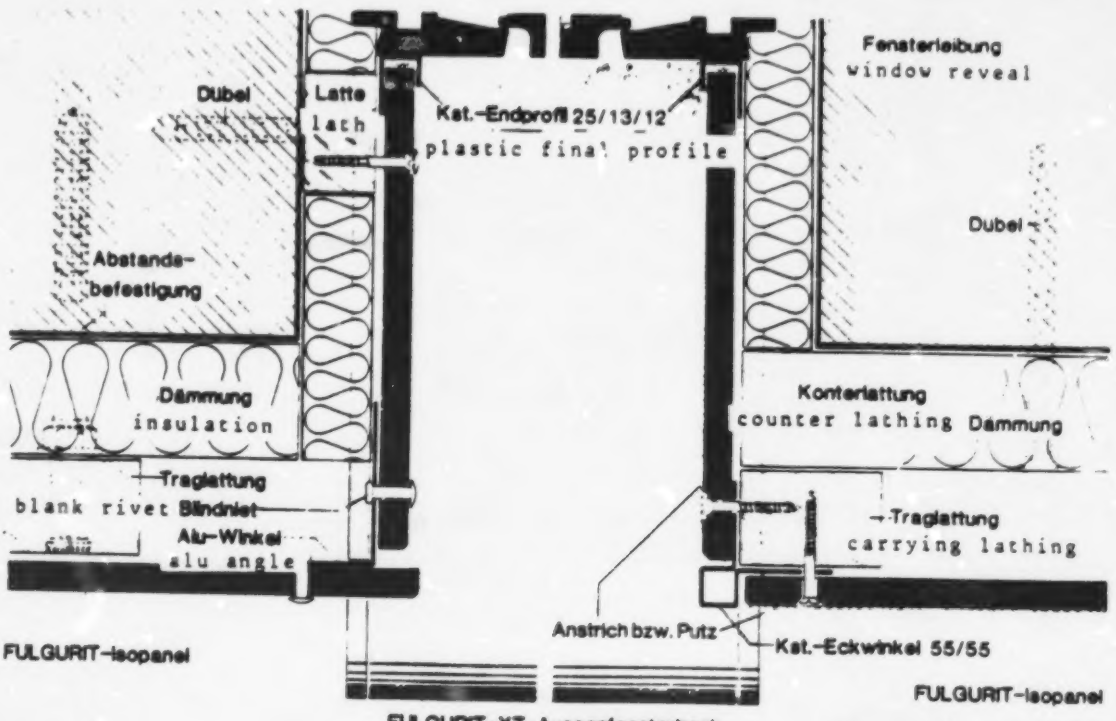


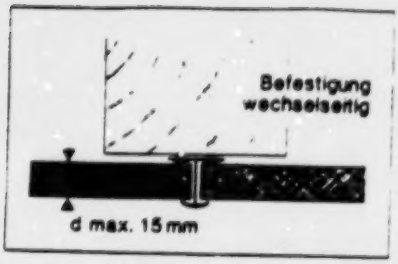
Bild 10

1 internal corner
2 fixation of spacing
3 lath (or strip or slat etc. ser translation or batten) given above

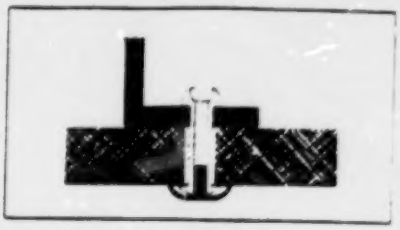


waagerechter Schnitt Bild 11

Means of fixation - succession

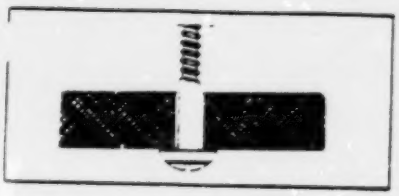


1) joint with plastic profile
from PROTEKTOR No. 3583
amongst others

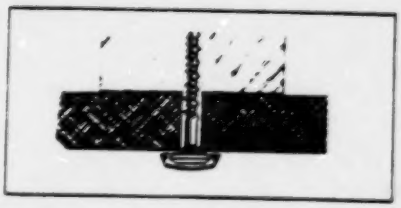


hollow tension rivet
(blank rivet)
amongst others available
from company HONSEL
fixation on light metal profile
board thickness at least 12 mm

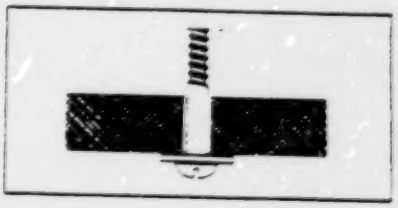
screw with 2 part coloured
WEBECO protection cap



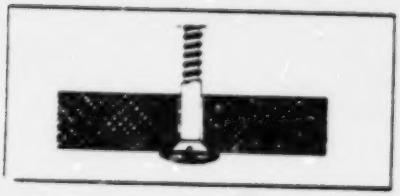
screw with rosette



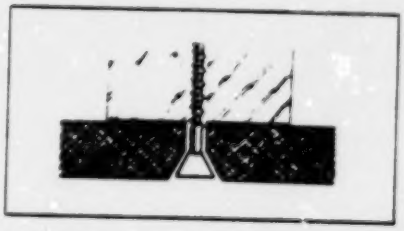
bore screw ("Bohrschraube")
with coloured plastic cap



screw with washer

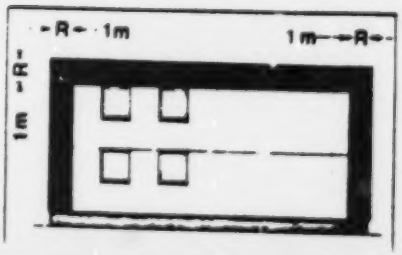


facade screw (lock screw)
with coloured plastic cap



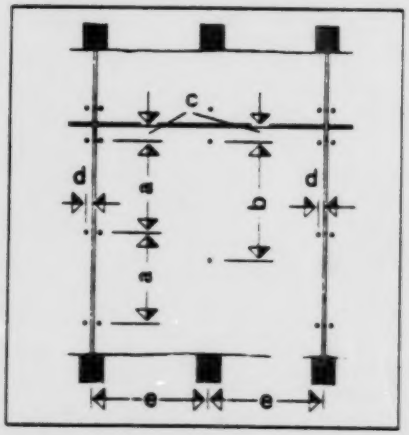
facade screw, self-boring
high-low thread with boring point,
self-sinking, cadmium coated
amongst others Company MAGE

5. Supporting and fixing spaces for buildings
of a maximum height of 8 meters
respectively 2 stories



FULGURIT-ISOPANEL thickness of board d = mm	W= wall surface R= edge area c min.	d min.		max. fixation and supporting distances with buildings of a height of 0-8 meters (mm) e	a	b
8*	50	25	W	400	200	400
			R	350	200	300
10*	50	25	W	400	200	400
			R	400	200	300
12	50	25	W	400	200	400
			R	400	200	300
16	50	20	W	625	300	625
			R	625	300	400
18	50	20	W	625	300	625
			R	625	300	400
20	50	20	W	625	300	625
			R	625	300	400
24	50	20	W	625	400	625
			R	625	400	500
28*	50	20	W	625	400	625
			R	625	400	500

* In the application licence for wooden houses built with the panel construction system only ISOPANEL boards in thicknesses of 12-24 mm are admitted, therefore the boards of 8, 10 and 28 mm thickness should not be used for facade cladding.



The recommendations of the makers of metal furring on other edge distances should be observed.
The same conditions apply in the case of static confirmatory checkings relating to a special project.

6. Applications recommended

a) The use of cement-bound wood chip boards FULGURIT-ISOPANEL is bound to the preconditions according to DIN 68800.

b) Transport and storage are to be carried out in such a manner that the moisture when supplied of 9±3 % is not exceeded.

c) The range of applications of ISOPANEL is restricted to buildings at the most two stories or a maximum of 8 m height.

d) External claddings, their furrings, means of fixation and anchorages must be executed of good structural and lasting stability and connected with the walls in such a manner that the stresses acting on them will be safely transferred to the massing.

e) The respectively valid regulations, guidelines and rules of technology (DIN standards) to be applied for furrings, means of fixation and anchorages (dowels etc.) remain binding in connection with cladding of external walls.

Regulations on preconditions for application issued by the local building authorities - in as far as they include restrictions on the structural stability, fire protection, protection against heat and sound insulation as against the note of authorization Lines 9.1 - 59 or our recommendations - are to be considered as having priority on principle.

f) Claddings of external walls with ISOPANEL including their respective furrings are to be carried out dimensionally accurate to such an extent that they fulfil their function and can be mounted fittingly. Higher requirements with regard to quality of coating with paints require the use of sanded boards; the same applies to connections with dimensionally accurate profiles and joints to be fitted into one another.

g) Inherent loads, wind, snow and ice loads according to DIN 1055 are to be transferred from the external cladding via the furring onto the anchored parts (on the main structure) by suitable measures. The same applies to additional loads from neon signs for advertising, protection against the sun or scaffolding anchors.

i) Alterations in shape to the concave or convex $=\frac{L}{125}$ with uncoated and $=\frac{L}{150}$ for coated external wall claddings made from ISOPANEL do not mean any functional restriction nor reduction of a property.

j) Furrings, fasteners and anchorages should be protected against corrosion. Furrings made from wood should always be treated with a chemical wood preservative agent according to DIN 68800, Part 3 "Wood Preservation in Rising Structures"; however, the preservative agent applied must not have any unfavourable effects on the ISOPANEL board itself nor on the mechanical fasteners, dowels, profiles, coating nor plasters, synthetic texture coatings etc. See over-leaf Wood Preservation.

k) When metal furrings or profiles are applied which owing to non-sufficient resistance to alkalis may cause a crevice corrosion (contact corrosion) (only in the case of uncoated boards), the points of contact are to be interrupted by means of a suitable coating material (e.g. bitumin) or with the aid of a waterstop.

l) Force-locking connections and fixities (or restraints) by unsuitable fasteners in the area of cladding to the furring should be avoided on principle.

m) As a protection against unfavourable influences on the surfaces such as unilateral drying, moisture or contamination, it is advisable in the case of cladding to be coated, to apply the primer coat before the assembly and/or the following coats immediately after the assembly. The edges freely exposed to moisture should always be protected by two coatings.

7. Coatings

Surface treatments with coating substances will be protecting the external wall cladding against damaging chemical and physical influences. It will depend on the requirements to be met with regard to the properties for use and the design features, which types of treatment will be necessary.

Prerequisite for the selection of the suitable materials is the observation of the specific properties of ISOPANEL with regard to the building material supplied (alkalinity pH 11-13).

The following coating materials with alkaline setting may be applied:

Polymerizate resin varnishes and paints
(acrylic resin varnish paints, polyvinyl chloride varnish paints)

Epoxy resin varnishes and paints
(EP varnish paints)

Polyurethane resin varnishes and paints
(reaction resin varnish paints of one or more components).

Chlorinated rubber varnish paints

Binders on an equal basis and combinations apply to the choice of foundation materials, fillers, surfaces and plasters. Suitable products for this purpose are offered by all makers of the paint varnish plaster and synthetic texture coating industry. The processing, functions and durability of all coating systems is determined by the equal-basis matching of the coating sequences by the impregnation, primering, sealing, level smoothening up to the coating (primer and top coating).

Based on this condition the recommendation concludes to adjust and reconcile to one another and to use on principle equal product systems.

For the detailed selection of suitable products please ask for our Information "coatings - Plasters - Fillers" (at present being prepared).

8. TECHNICAL DATA

See prospectus FULGURIT-ISOPANEL January 1982 Edition, pages 14 and 15 and previous translations.

9. SUPPLIER COMPANIES FOR ACCESSORIES

Alu Flat profiles
VAW Leichtmetall GmbH
Schlörumpfskoppelweg, 3000 Hannover 91

Facade profiles plastic
FULGURIT GMBH & CO.
Kommanditgesellschaft
Postfach 1208, 3050 Wunstorf 1

Screws
MAGE Gehring GmbH
Postfach 368, 7290 Freudenstadt

Dowels
Fischer-Werke, Artur Fischer GmbH & Co. KG
7244 Tumlingen/Waldachtal 3

Light metal Furring
Harpenfeld Bauelemente GmbH
Postfach 3540, 4500 Osnabrück

Facade profiles Plastic-Alu
Protektorwerk Fl. Maisch GmbH & Co. KG
Postfach 1420, 7560 Gaggenau

Glasfibre mats
Gerberts GmbH
Postfach 200244, 5600 Wuppertal

Rivets
Alfred Honsel, Nieten- und Metallwarenfabrik
Postfach 1220, 5758 Fröndenberg/Ruhr

Wood preservation
Desowag-Bayer Holzschutz GmbH
Postfach 320220, 4000 Düsseldorf

APPENDIX E.

Isopanel, zementgebundene Holzspanplatte

Produktionszahlen und Erlösdaten mit Einzelheiten zur Abschätzung des Marktes und Berechnung der Produktionskosten im eigenen Land.
Tageskapazität 87 Tonnen = 70 m³. Die Dichte von Isopanel beträgt 1.25. Mitarbeiter Gesamt 60 in 3 Schichten.

Beschreibung	A Erlös/Kosten DM/to	B Erlös/Kosten %	C Erlös/Kosten Ihr Erlös und Eigenkosten; falls unbekannt, unsere Zahlen benutzen und in Eigenwährung umrechnen	D Zusätzliche Daten: Benötigtes Material und Energie pro produzierte Tonnen
Bruttolistenpreis	1.127,--			12 mm Stärke
Rabatt @ 25 %	282,--			an den Handel
Skonti @ 2,5 %	21,--			
Netto Erlös	824,--	100,--		Inland Erlöse 1986
Holz	34,--			320 kg
Zement	87,--			652 kg
Zusätze	11,--			29 kg
Rohstoffeinsatz	182,--	22,1		
Strom	35,--			180 KW
Gas	25,--			48 m³
Wasser	-			360 kg
Energie	60,--	7,3		
Instandhaltung	30,--	3,6		Werkzeuge, Hilf-Stoffe Reparaturen
Personalkosten	95,--	11,5		32. Mitarbeiter Produktion
Paletten	12,--	1,5		
Verluste/Sicherheit	4,--	0,5		auf Rohstoffeinsatz 2,5 %
Summe variable Kosten	383,--	46,5		Kv-Produktion
Deckungsbeitrag I	441,--	53,5		Zur Abdeckung der Fixkosten
Personalkosten	83,--	10,0		28 Mitarbeiter
Versicherungen, Gebühr, Staplerkosten, sonst.	30,--	3,6		
Abschreibungen	30,--	3,6		Annahme
Wagnisse	13,--	1,6		
Zinsen	21,--	2,5		Annahme
Hallenheizung	3,--	0,4		nur im Winter
Summe fixe Kosten	180,--	21,8		
Deckungsbeitrag	261,--	31,7		Zur Abdeckung: 1) Frachtkosten 2) Rabattveränderung 3) Gewinn

Isopanel Cement Bonded Particleboard
(Translation)

Production and revenue data with specifics to evaluate market and product cost relations.

Daily capacity 87 tons = 70 m^3. Density of 1.25. Total of 60 employees for 3 shifts.

Description ($1 Can.=1.40 DM)	Revenue/Cost Dollars/Ton	Revenue/Cost %	Additional Data
Gross List Price	$ 805.00		12 mm thickness
Dealer discount (25%)	201.00		
Cash discount (2.5%)	15.00		
Net Price	589.00	100.0	Inland West Germany 1986
Wood	60.00		320 kg
Cement	62.00		652 kg
Additives	8.00		29 kg
Total raw materials	130.00	22.1	
Electricity	25.00		180 kw
Gas	18.00		48 m^3
Water	-		360 kg
Total energy costs	43.00	7.3	
Maintenance	21.00	3.6	Tools, repairs & materials.
Salaries	68.00	11.5	32 production workers
Pallets	9.00	1.5	
Losses/insurance	3.00	.5	Raw material
Total variable costs	33.00	46.5	
Subtotal	315.00	53.3	To cover fixed costs.
Salaries	59.00	10.0	28 Supervisory/administration
Insurance-taxes-fees	21.00	3.6	
Depreciation	21.00	3.6	Assumption
Bad debts	9.00	1.6	
Interest	15.00	2.5	Assumption
Heating	2.00	.4	Only in winter
Total Fixed Costs	129.00	21.8	
Subtotal	$ 186.00	31.7	For that total: 1) Freight 2) Discount charges 3) Profit

Anlage zur Herstellung von Holz -

zementgebundenen Spanplatten

Anlage Baujh. 1975

Leistung: ca. 20.000 to. jährlich bzw. 17.000 m³ bei 12 - 16 mm St.,
Formate 2.800 x 1.250 mm + 3.200 x 1.250 mm,
in Stärken von 8 - 28 mm (6 - 40 mm 1.A.)

Personal: 55 Personen f. 3 Schichten

Maschinen bestehen in der Hauptsache aus:

Holzplatz/Spanaufbereitung:

+ HZ-Mischanlage

Zerspanung Homback, Typ U 28
Vorratsbunker
Hammermühle Bison, Typ 85/200
Siebung Allgaier, TypeTSM 2000
Feingutmühlen Pallmann, Typ PSKM 10
Bandbunker + Feingutbunker Typ BK25+S20T
Chemikalienmisch + Dosieranlage Bison

Formstation + Blechumlauf
+ Transportanlage

Formstrang mit Streuanlage Bison/Winstg.
Pressenanlage/Unterdruckpresse Bison/Metz
Härte + Klimakammer-Anlage Bison/Fulgurit
Blechreinigungsanlage

Endbearbeitung

Format + Bearbeitungs-Zuschnittanlage
Thermoölanlage f. Härte- und Klimakammer
div. Transporteinrichtungen f. Auslagerung

Fulgurit Cement Bonded Particleboard Plant
(Translation)

Installed in 1975

Capacity:

Approx. 20,000 tons annually i.e. 17,000 m^3 at 12 - 16 mm in thickness

Size: 2.800 x 1.250 mm or 3.200 x 1.250 mm, in thickness of 8 - 28 mm
(6 - 40 mm designed)

Personnal:

55 people for 3 shifts.

Woodyard/Fibre Preparation:

Flaker - Type U28 Hombeck,
Storage bin,
Hammermill - Type 85/200 Bison,
Screen - Type TSM 2000 Allgaier,
Refiner - Type PSMM 10 Pallman,
Storage silos - Type BK25 BauHunker, S20T Feingutbunker,
Additive, mixing & measuring equipment - Bison.

Forming Station/Caul Circulation

Forming station - Bison/Winstg.,
Press - Bison/Metz,
Hardening & climatization chamber - Bison/Fulgurit,
Caul cleaner.

Finishing:

Trimmer,
Hot oil boiler for hardening and climatization,
Various transport equipment for warehousing.

Personalplan

1. Bei voller Jahresproduktion = 20.000 to

	Schichten I.	II.	III.	Normalschic
Schichtführer (Schlosser)	1	1	1	-
Springer (Elektriker)	1	1	1	-
Zerspaner	1	1	1	-
Mischermann	1	1	1	-
Maschinenführer	1	1	1	-
Pressenbedienung	1	1	1	-
Staplerfahrer	1	1	1	-
Klimakammer	2	2	2	-
Besäumsäge	-	-	-	7
Besäumsäge Schichtführer	-	-	-	1
Doppelendprofiler	2	2	2	-
Messerschleifer f. Zerspaner	-	-	-	1
Elektriker	-	-	-	1
Schlosser	-	-	-	1
Inspektion	-	-	-	-
Lager (1 Staplerfahrer, 2 Helfer)	-	-	-	3
Labor	-	-	-	-
Holzplatz	-	-	-	1
Kontrolle	-	-	-	1
Raumpflege Halbtagskraft	-	-	-	1
	11	11	11	17

	50
+ 8 % Urlaub u. krank	4
	54
+ Angestellte (Verwaltung u. Vertrieb)	6
	60

Fulgurit Cement Bonded Particleboard Plant
Labour Requirements
(Translation)

For a total annual production of 20,000 tons.

Job Description	Shifts I	Shifts II	Shifts III	Maintenance & Warehouse	
Shift supervisor	1	1	1	-	
Mechanical electrician	1	1	1	-	
Flaker	1	1	1	-	
Mixer	1	1	1	-	
Machine operator	1	1	1	-	
Press operator	1	1	1	-	
Forklift operator	1	1	1	-	
Climate chamber operator	2	2	2	-	
Trim saw operator	-	-	-	7	
Trim saw supervisor	-	-	-	1	
Tenover operator	2	2	2	-	
Grinder	-	-	-	1	
Electrician	-	-	-	1	
Forklift operator	-	-	-	3	
Woodyard worker	-	-	-	1	
Inspector	-	-	-	1	
Cleaning personnel	-	-	-	1	
	11	11	11	17	50
+ 8% sick leave holidays					4
					54
+ office staff					6
					60

Appendix F

(From information added by Ligna Technologies, January 1988).

CURRENT SELLING PRICES OF CEMENT-BASED PANELBOARDS AVAILABLE IN CANADA
(November 1987; 10 mm (3/8") thickness)

Trade name	Manufacturer	Density lbs/ft^3	Price $/ft^2$	* /4'x8'
Eterspan	Eternit, Germany	68.4	$2.69	$ 86.08
Eterboard	Eternit, Germany	96.0	$4.48	$143.36
C.W. Board	Guadiana, Mexico	74.0	$1.05	33.60

* Prices quoted are "F.O.B. Toronto" and do not include transportation/delivery charges

Appendix G

(From information added by Ligna Technologies, January, 1988)

ADDENDUM TO FINANCIAL ANALYSIS: CASH POSITION OF THE "FULGURIT ALTERNATIVE" WITHOUT GOVERNMENT CONTRIBUTION.

	Year 1	Year 2	Year 3	Year 4	Year 5
Net increase in interest costs	$113,881	$118,009	$89,911	$ 57,934	$ 21,544
Total corporate (loss) or profit	(757,957)	84,919	755,777	1,404,329	2,220,861
Cash position	(95,340)	89,369	474,240	1,659,077	3,624,738

Note that the working capital requirement would increase from $529,750 to approximately $700,000.